Original Article

Role of Ischiopubic Index in Sex Determination on Pelvis X-rays

Ayesha Haider[1], Sohail Kamran[2], Muhammad Arif [3], Danish Raouf [4]

[1]Assistant Professor Department of Forensic Medicine, Federal Medical & Dental College Islamabad
[2]Radiologist Department of Diagnostic Radiology, National Institute of Rehabilitation Medicine Islamabad
[3]Associate Professor Department of Forensic Medicine, Islamabad Medical & Dental College Islamabad
[4]Doctor of Physical Therapy, Institute of Medical Rehabilitation Islamabad

Correspondence: *Dr Ayesha Haider*
Assistant Professor Department of Forensic Medicine Federal Medical & Dental College Islamabad
drayeshahaider@hotmail.com

Abstract

Objective: To find out sexual dimorphism in hip bones with respect to pubic and Ischial lengths and their index.

Methodology: A descriptive cross-sectional study was done at the National Institute of Rehabilitation Medicine Islamabad from January to April 2019. Total 120 patients who underwent Pelvic radiographs were included. The Pubic length, Ischial length and the Ischiopubic index were measured. Pubic length is a straight line drawn on the radiograph from center of the Triradiate cartilage to the medial end of pubic symphysis. Ischial length is a straight line drawn from Triradiate cartilage perpendicular to the line joining the bilateral lower Ischial tuberosities. Ischiopubic index is determined from the pubic length divided by ischial length and then multiplied by 100.Independent simple t.test was applied. Data was analyzed by SPSS version 17.

Results: The mean values of pubic length for males in pelvic radiograph were found to be 53.01±6.02mm and that of female were found to be 57.33±7.68mm. The pubic length in females was observed to be higher than in males. These differences were observed to be statistically significant ($p<0.007$). The mean values of ischial length for males in pelvic radiograph were found to be 60.68±5.63mm and that of female were found to be 50.31±7.04mm. The ischial length in males measured more than that of females. Differences observed were statistically significant ($p<0.012$). The mean values of ischiopubic index for males in pelvic radiograph were found to be 85.21±5.18 and that of female were found to be 111.15±5.66. The ischiopubic index of the females was higher than that of males. These differences were observed to be statistically significant ($p<0.027$).

Key words: Ischial length, Ischiopubic index, Pelvic radiograph, Pubic length.

Cite this article as: Haider A, Kamran S,Arif M, Raouf D. Role of Ischiopubic Index in Sex Determination on Pelvis X-rays.J Soc Obstet Gynaecol Pak. 2019; Vol 9(4):231-234.

Introduction

The accurate identification of sex & race of individuals from human skeleton is an integral part of forensic sciences and anthropology. Significant morphological differences exist amongst Caucasoid, Mongoloid and Negroid races; strongly supported by literature.[1,2] Age, sex, race and stature are four main characteristics for identification of individuals from skeletal remains. Sex of human skeleton can be identified by visual as well as metric analysis. [3] Ischiopubic index is important in forensic and physical anthropology in the identification of unknown sex as it can provide new, cheap and more accurate means of determining sex and race when the need arises.[3] No significant differences have been seen to exist between studies from skeletal remains and radiological pelvimetry. [3]

Studies show utilization of different methods for identification of sex with varying degree of accuracy. A lot of research articles are available on identification of

Authorship Contribution: [1-3] Substantial contributions to the conception or design of the work, acquisition, analysis, or interpretation of data for the work Final approval of the version to be published, [4]drafting the work or revising it critically for important intellectual content

Funding Source: none
Conflict of Interest: none

Received: Aug 28, 2019
Accepted: Jan 21, 2020

sex from the human skeleton utilizing different elements. After analysis of studies performed on the assessment of identification of sex from human bones it was found that some parameters are more accurate than others.[4]

Pelvic girdle, skull and long bones are mostly utilized for identification of sex besides other bones. Out of different bone, the pelvic girdle is considered to be more reliable for giving up to 95% accurate results.[5] Ischiopubic index is the ratio of pubic length to ischial length multiplied by 100. The pubis and ischium are parts of the pelvic bone. The pelvic bone (innominate bone) consists of three parts which are the ilium, ischium and pubis. These bones are joined together to form the acetabulum which is directly lateral with the ilium lying superiorly. The pelvic bones develop endochondrally, where initially a cartilaginous anlage or template of the bone develops and is later infiltrated by bone tissue, creating centers of ossification.[6] Each of the three bones is formed from its own primary center of ossification; five secondary ossification centers develop later on. [7] The anthropometric study of the hip bone and its sexual dimorphism is of interest in the field of anthropology, forensic science, anatomy and clinical sciences (gynecologist and obstetrics). [8] The hip bone is an ideal bone for sex determination because; it not only reflects the general differences between the two sexes (male and female) but also has the special adaptation of female hip bone for child bearing. [9]

These measurements of hip bone are important for accurate identification of sex and race in the human skeleton and are highly recommended for obstetricians, forensic and physical anthropologists. [10] Reports have suggested that data on pelvic bone can be considered for forensic science.[11] However, the probable limitations could arise from using radiographs of young individuals. This is because, the secondary ossification of the ilium, ischium, and pubis do not ossify until about 20-25 year.[12] Sexual dimorphism in human pelvis is mainly due to more growth in width than height of the female pelvis during skeletal growth to prepare it for pregnancy & delivery.

The main differentiating characters of the female pelvis are that pelvic inlet, sub pubic arch and greater sciatic notch are wider than males. [13]

More accurate identification of the sex of human pelvis can be done by the objective method of measuring different anatomical landmarks than the subjective method of visual identification. [14]

In a study, it was stated that hip bone is the most reliable of all bone for sex determination.[15]

Results of a study on skeletal remains & anterio-posterior radiographs of pelvis simultaneously to assess sex; showed that there is no significant difference between results obtained from study of bone itself or its radiographs; hence ischiopubic index can be reliably estimated from radiographic pelvimetry. [16]

Our study performed on hip bone X rays for sexual dimorphism can be of great value in physical anthropology, anatomy, gynecology to estimate the progress of labor, archeological analysis and solving medico legal cases.

Methodology

A descriptive cross-sectional study was conducted in the National Institute of Rehabilitation Medicine hospital (NIRM) Islamabad from January to April 2019. Normal AP radiographs of Pelvis of 120 patients of both sexes (60 each) aged between 20 to 65 years were included. Patients with a history of trauma of pelvis and underlying bone diseases which could affect pelvic bone were excluded. These radiographs were performed in anterior-posterior view by using Siemens x-ray machine. All radiographs were taken at a distance of 100cm. Only radiographs with the best alignment at the inferior margins of the pubic bones at the pubic symphysis were measured. Measurement was carried out by choosing 3 points on the radiographs; Points A, B and C. Point A was the acetabular point where the three pelvic bones meet. Points B and C were the pubic tubercle and ischial tuberosity respectively. A marker was used to mark these points for clear visualization. The distance between these points were then measured with the aid of vernier caliper. Distance AB gave the pubic length while AC gave the ischial length. Each distance was measured twice and the average recorded as the actual distance to ensure accuracy. The distance AB was divided by the distance AC and multiplied by 100. This gave the ischiopubic index. (IP = AB/AC X 100). Results were compared with previous studies on other populations. Statistical analysis was carried out with the help of SPSS version 17 and Microsoft Excel. The mean, standard deviation of pubic length, ischial length and ischiopubic index and correlation between pubic length, ischial length and ischiopubic index with the gender were expressed in tables and figures. Data was presented as mean and standard deviation for all variables. Data obtained were analyzed using the descriptive statistics to summarize

the information, and inferential statistics (independent samples t-test) to verify if there were significant sex differences. P<0.05 was considered to be statistically significant. Detailed results are shown in the tables and figures below:

Results

The mean values of pubic length for males in pelvic radiograph were found to be 53.01±6.02mm and that of female were found to be 57.33±7.68mm (Table I). The pubic length in females was observed to be higher than in males. These differences were observed to be statistically significant (p<0.007). The mean values of ischial length for males in pelvic radiograph were found to be 60.68±5.63mm and that of female were found to be 50.31±7.04mm (Table I). The ischial length in males measured more than that of females. These differences were observed to be statistically significant (p<0.012). The mean values of ischiopubic index for males in pelvic radiograph were found to be 85.21±5.18 and that of female were found to be 111.15±5.66 (Table I). The ischiopubic index of the females was higher than that of males. These differences were observed to be statistically significant (p<0.027).

Table I: Demographics of Males and Females of Bone Length (Pubic & ischial)

	Gender	N	Mean	Std. Deviation
Pubic Bone length	**Male**	60	53.0167	6.02956
	Female	60	57.3333	7.68593
Ischial Bone length	**Male**	60	60.6833	5.63431
	Female	60	50.3167	7.04583
Ischio-Pubic Index	**Male**	60	85.2167	5.18502
	Female	60	111.1500	5.66830

Discussion

In the present study; ischial lengths, pubic lengths and ischiopubic index were assessed regarding their dimorphic nature as well as the degree of identification. The mean values of ischial length for males in pelvic radiograph were found to be higher than females. The mean values of pubic length for males in pelvic radiograph were smaller than that of females. The mean values of ischiopubic index for males in pelvic radiograph were found to be 85.21±5.18 and that of females were found to be 111.15±5.66. The mean ischial length was significantly higher in males than in females while the mean pubic length and ischiopubic index in females were significantly higher than in males (P < 0.05). Sexual dimorphism of ischiopubic index has been reported and several studies in America, Europe, Australia and Africa &Asia show female pubis to be longer than males and female ischium to be shorter than males leading to a mean higher ischiopubic index in females. Results of our study are close to Nirmale et all[17] whose study was done on the population of Maharashtra India; are also in agreement with some previous studies done at Nigeria. [17, 18.19-26] Our results were at a variance with a study conducted in Portugal [30] that reported that the mean ischiopubic index in males was greater than in females. This dispersion might be related to genetic and environmental factors; which are known denominators for intra- and inter-population variability. The mean ischial and pubic lengths in this study are lower than some studies conducted previously.[17,20,21] The mean value of ischiopubic index in the present study was similar to some previous reports [20,21] and Oladipo et al. [18] These differences in skeletal forms and morphology might be adduced to genetics and environmental factors such as nutrition. In a study done on Egyptian populations, results were similar to our observations.[27]

Washburn 1948[28] claimed 84%male and 100% female sorting of hip bone with ischiopubic index only. The importance of ischiopubic index in obstetrics cannot be over emphasized. It has been observed that the size of ischiopubic index determines the size of birth canal; which is an important criteria in vaginal delivery.

Conclusion

To conclude pelvic bone can be used for identifying a person through identification of sex by determining

Table II: Independent t-test

	Sig.	t	df	P	Mean Difference	Lower	Upper
Pubic Bone length	.007	-3.42	118	.001	-4.31	-6.81	-1.81
		-3.42	111.67	.001	-4.31	-6.81	-1.81
Ischial Bone length	.012	8.90	118	.000	10.36	8.06	12.67
		8.90	112.55	.000	10.36	8.05	12.67
Ischio-Pubic Index	.027	-26.14	118	.000	-25.93	-27.89	-23.96
		-26.14	117.07	.000	-25.93	-27.89	-23.96

ischiopubic index. The mean values of ischiopubic index are less for males than for females and the differences were statistically significant. The present study has provided a detailed study of the ischiopubic index statistically significant; sexually dimorphic parameter which might serve in sex determination even when fragmentary remains of hip bone are available to comment upon the sex of the dead & decomposed skeletons. Study of ischiopubic index bears significant observation in obstetrics, radiology, forensic and anthropological sciences.

References

1. Oladipo G.S, Okoh P.D and Suleiman Y.A. Radiologic studies of public length, ischial length and ischiopubic index of Easternpeople of Nigeria. Research Journal of Medicine and Medical Sciences.2010; 5(2): 117-120.
2. Schultz A.H. The skeleton of the trunk and limbs of higher primates. Human Biology.1930; 2:303438.
3. Peckmann TR, Meek S, Dilkie N, Rozendaal A. Determination of sex from the patella in a contemporary Spanish population. J Forensic Leg Med
4. Ekizoglu O, Hocaoglu E, Inci E, Bilgili MG, Solmaz D, Erdil I, et al. Sex estimation from sternal measurements using multidetector computed tomography. Medicine (Baltimore) [Internet]. 2014 Dec; 93(27):e240. http://www.ncbi.nlm.nih.gov/pubmed/25501090
5. Afrianty I, Nasien D, Kadir MRA, Haron H. Determination of gender from pelvic bones and patella in forensic anthropology: A comparison of classification techniques. Proc - 1st Int Conf ArtifIntell Model Simulation, AIMS. 2013. 2014; 3–7.
6. Chaurasia BD. Human Anatomy. 5th edition. CBS publisher and distributers pvt Ltd. 2010;419.
7. Moore KL, Dalley AF, Anne MR, Marion, EM. Clinically Oriented Anatomy. 5th edition. Lippincott Williams and Wilkins. 2006; 358-363.
8. Oladipo GS. Radiologic study of pubic length, ischial length and ischiopubic index of south-south and middle belt Nigerians. Journal of Applied Bioscience. 2009; 23:1451-1453.
9. Ekanem T, Udongwu A, Singh SP. Radiographic determination of sex differences in Ischiopubic index in of a Nigerian population. The Internet Journal of Biological Anthropology. 2009;3(10):5580.
10. Oladipo GS, Ugboma HAA, Suleiman YA.Comparative study of sub-pubic angles in adult Ijaws and Igbos. Asia Journal of Medical Science. 2012;1(2):26-29.
11. Schultz AH. The skeleton of trunk and limbs of higher primates. Human Biology. 1930;2:303-348.
12. Oladipo GS, Erojie MA, Johnbull TO.Comparative study of Ischiopubic Index of South-south and Middle-belt people of Nigeria. Research Journal of Medicine and Medical Sciences. 2010;5(1):87-90.
13. Taranger J, Hägg U. The timing and duration of adolescent growth. Acta Odontol Scand; 38(1):57–67. http://www.ncbi.nlm.nih.gov/pubmed/6929640
14. Ostrofsky KR, Churchill SE. Sex Determination by Discriminant Function Analysis of Lumbar Vertebrae. J Forensic Sci. 2015; 60(1):21–28: http://www.ncbi.nlm.nih.gov/pubmed/25382679
15. Okoseimiema S.C, Udoaka A.I, radiologic determination of ischiopubic index in South –south Nigerian population 2013. AJMS. 2013; 5:96-100
16. Chris-Ozoko LE, Ebeye OA, Ufuoma TP. Anthropometric study of ischiopubic index of the Isoko and Benin in Nigeria. East African medical journal. 2014;91(10):375-378.
17. Nirmale VK, Laeeque M, Diwan CV. Assesment of reliability of various criteria used in adult hip bone sex differentiation. Int J Anat Res. 2016; 4(4):3185-89.
18. Oladipo GS, Anugweje KC, Rosemary EO, CU Godwin. Radiologic study of ischiopubic index of Urhobos and Itsekiris of Nigeria. Br J Med Med Res 2015; 5:1114-20.
19. Ekanem TB, Akpan EJ, Mesembe OE. A study of ischiopubic index using x-ray films in Lagos state of Nigeria. Adv Anat 2014; 2014:1-4.
20. Oladipo GS, Anugweje KC. Ischiopubic index of a Nigerian population residing in rivers state. Curr Trends Technol Sci 2014; 3:80-85.
21. Osunwoke EA, Olotu EJ, Allison TA, Oriji CN, Mbadugha CC. The discriminant formula for the determination of sex of adults in a Nigerian population (using pelvic radiographs). J Nat Sci Res 2013; 3:176-80.
22. Okoseimiema OC, Udoaka AI. Radiologic determination of ischiopubic index in south-south Nigerian population. Asian J Med Sci 2013; 5:96-100.
23. Oladipo GS, Okoh PD, Leko B. Radiologic studies of pubic length, ischial length and ischiopubic index of adult Kalabaris and Ikwerres of Nigeria. J Med Med Sci 2012; 3:99-102.
24. Oladipo GS, Okoh PD, Suleiman YA. Radiologic studies of public length, ischial length and ischiopubic index of eastern people of Nigeria. Res J Med Med Sci 2010; 5:117-20.
25. Igbigbi PS, Msamati BC. Ischio-pubic index in adult black Malawians. East Afr Med J 2000; 77:514-6.
26. Phenice TW. A newly developed visual method of sexing the OS pubis. Am J Phys Anthropol 1969; 30:297-301.
27. Saleh / Ain Shams J Forensic Med Clin Toxicol, January 2014 (22):114-118
28. Washburn SL. Sex Differences in the Pubic Bone of Bantu and Bushman. Am. J. Phys. Anthrop. 1949; 7:425-432.