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Original Research Article

A STUDY OF SEXUAL DIMORPHISM IN ISCHIOPUBIC INDEX OF ADULT HUMAN HIP BONES

Ankit V. Adhvaryu *[1], Mina Patel [2], Dilip V. Gohil [3], Mital M. Patel [4].

*[1] Assistant Professor in Anatomy, M. P. Shah Govt. medical college, Jamnagar, Gujarat, India.

[2] Associate Professor in Anatomy, M. P. Shah Govt. medical college, Jamnagar, Gujarat, India.

[3] Associate Professor in Anatomy, M. P. Shah Govt. medical college, Jamnagar, Gujarat, India.

[4] Professor & Head, Department of Anatomy, M. P. Shah Govt. medical college, Jamnagar, Gujarat, India.

ABSTRACT

Introduction: Sex determination of a skeleton remains is very important to the anatomists, anthropologists as well as forensic experts. The innominate has long been recognized as one of the most reliable skeletal indicators of sex in adult human beings. Three common parameters used by Derry (chilotic line index), Washburn (ischiopubic index) and Schulter Ellis (acetabulum pubic index) claimed to identify sex in high percentage of hip bones. Jit and singh (1966) suggested use of Demarking points (DP) to identify sex of the bone to highest accuracy. Present study was done to study sexual dimorphism in Ischiopubic index of hip bone and to study accuracy of Demarking Points of ischiopubic index in identifying a bone of a particular sex.

Materials and Methods: In present study, total numbers of 111 adult human hip bones 79 male and 32 female in department of Anatomy, M. P. Shah Govt. Medical College, Jamnagar, Gujarat were selected, their pubic length and ischial length were measured; Ischiopubic index calculated; DP for ischiopubic index determined.

Results: There was statistically significant difference in Ischiopubic index of male and female hip bones which was in accordance with previous studies. Also DP of present study was different from other studies.

Conclusion: Ischiopubic index differs from population to population and region to region in same population; also DP method has certain limitations in sex determination. Therefore present study points towards a need for proper standardization of Mean Ishciopubic index as well as Demarking Point method for individual population, race etc for better identification of male and female hip bones.

KEY WORDS: Ischiopubic index, Demarking points, Sexual dimorphism.

Address for Correspondence: Dr. Ankit V. Adhvaryu, Assistant Professor in Anatomy, M. P. Shah Govt. medical college, Jamnagar, Gujarat, India. **E-Mail:** ankit_adhvaryu@yahoo.co.in

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INTRODUCTION

The sex has to be determined in case of 1) heirship 2) marriage 3) divorce 4) legitimacy 5) impotence 6) rape etc. Recognizable sex differences do not appear until after puberty except in the pelvis [1].

Sex determination of a skeleton remains is very important to the anatomists, anthropologists as well as forensic experts. The innominate has long been recognized as one of the most reliable skeletal indicators of sex in adult human beings [2]. In past, many workers have evolved various metrical parameters and indices for sexing of hip bone, Derry (1923),

Straus(1927), Washburn (1949), Davivong (1963), Jovanovic and Zivanovic, (1965), Jovanovic et al (1968), Singh and Potturi (1978), Schulter Ellis (1983), Turner (1986), Pal Bose and Choudhary (2004) [3]. Three common parameters used by Derry (chilotic line index), Washburn (ischiopubic index) and Schulter Ellis (acetabulum pubic index) claimed to identify sex in high percentage of hip bones. Using the chilotic line index Derry (1923) sexed 40% of the hip bones, while Washburn (1949) claimed that 84% male and 100% female American skeletons could be identified by this ischiopubic index [3].

According to Jit & Singh (1966) [4] in medicolegal cases, where 100% accuracy is demanded, the range for the maximum and minimum limits has to be calculated by adding and subtracting 3 SD to and from the mean value of each measurement. Such functional points based on calculated ranges have been named demarking points by Jit & Singh.

The present study was carried out to study sexual dimorphism in Ischiopubic index of adult human hip bones and to study the accuracy of Demarking Points of ischiopubic index in identifying a bone of a particular sex.

MATERIALS AND METHODS

In present study, total numbers of 111 adult human hip bones 79 male and 32 female in department of Anatomy, M. P. Shah Govt. Medical College, Jamnagar, Gujarat were selected and studied.

Selection criteria: They should be recorded in department, Anatomically matured and fully ossified; unbroken without loss of any piece of bone

Excluding criteria: Pathologically deformed, malformations, osteophyte or any other features other than normal, Normal bones without records**Ischiopubic Index was calculated as follows:**

Length of pubis (AB)=it measures the straight distance between the mid-point of the acetabulum and upper margin of the symphysis [5]. **1st** point **(A)** at the meeting point of all three parts of hip bones at acetabulum, where light is easily passed is the identification when set towards the fully light area. **2nd** point **(B)** is mark at superior part of symphyseal surface of pubic bone. Now distance between these two points is measured by **digital vernier caliper.**

Length of ischium (AC)= it measures the straight distance between the mid-point of the acetabulum to deepest point of the ischial tuberosity [5] - **1st** point **(A)** is same as pubic length. **2nd** point **(C)** is mark on maximum convexity of ischial bone farthest to 1st point. **Ischiopubic Index** = Length of pubis / Length of ischium *100 [3].

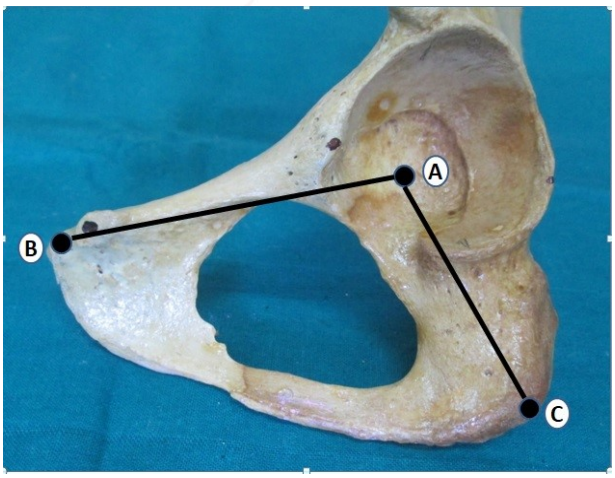
After calculating Ischiopubic index of male and female bones, Demarking Points were calculated by formula of Mean ± 3SD so as to cover 99.75% of bones.

Number of bones of a particular sex identified beyond DP were calculated and tabulated.

All the observations were tabulated and tested for statistical significance by applying Z test / t test. All the calculations were done using Epi Info 7 Software and Microsoft office Excel 2007.

The findings of present study were compared with that of other studies for statistical significance.

Fig. 1: Showing the Ischiopubic Index measurements.



DISCUSSION

As shown in Table 1, The mean Pubis length was higher in females while mean ischial length was higher in males and the difference was statistically significant (P<0.05). The range of Ischiopubic index for male hip bones was 86.84-116.92 with mean value of 100.52 and S.D. 6.33, while for female hip bones together, it was 101. 20 – 136.07 with mean value of 115.88 and SD 10.07. The difference was statistically significant (P<0.01). This was in accordance to the

other studies of Pal GP et al[3], Kanika S et al[6] and Gupta R et al[7].

As shown in Table 2, On comparing the mean ischiopubic index of male hip bones of present study with that of other studies, the difference in mean was statistically not significant for Pal GP et al[3]; it was statistically significant with and Kanika S et al[6] and statistically highly significant with Nirmale et al[8] and Gupta R et al[7].

As shown in Table 3, On comparing the mean ischiopubic index of female hip bones of present study with that of other studies, the difference in mean was statistically not significant with Kanika S et al[6]; it was statistically significant with Nirmale V et al[8] and Gupta R et al[7]; statistically highly significant with Pal GP et al[3]. As shown in Table 4, On comparing the mean ischiopubic index of male and female hip bones of present population with other populations, it was found that the difference was statistically highly significant for both male and female ischiopubic index.

Therefore, as shown in Table 3, 4, and 5 there was statistically significant difference between mean of male and female ischiopubic index of Indian population and other populations respectively; also there was statistically significant difference between mean of male and female ischiopubic index of different regions of Indian population respectively.

Table 1: Sexual Dimorphism in Hip Bones.

	Pubic Length		Ischial Length		Ischiopubic index	
	Male	Female	Male	Female	Male	Female
Range	57 - 92	70 - 85	64 - 86	61 – 83	86.84 – 116.92	101.20 – 136.07
Mean	74.03	77.5	73.67	67.16	100.52	115.88
SD	6.87	5.33	5.41	5.27	6.33	10.07
Z Value	-2.85 (p < 0.05)		5.85 (p < 0.01)		-8.01 (P<0.01)	
Present study			DP*		< 85.66	> 119. 50
			% beyond DP		0	37.5
Pal GP et al[3] study			DP*		> 102.14	< 84.97
			% beyond DP		27.27	17.7

Table 2: Comparison of Ischiopubic Index of Male Hip Bones with other studies.

	Range	No.(n)	Mean	SD	Z value	P value
Present study	86.84 – 116.92	79	100.52	6.33		
Pal et al [4]	86.40 – 114	143	100	5.01	0.63	> 0.05
Nirmale V et al [8]	84.75 – 138.05	124	116.87	9.05	-15.13	< 0.001
Kanika S et al[6]	-----	80	98.27	7.33	2.07	< 0.05
Gupta R et al[7]	105.97 – 137.34	50	121.059	8.013	-15.34	< 0.001

Table 3: Comparison of Ischiopubic Index of Female Hip Bones with other studies.

	Range	No.(n)	Mean	SD	Z value	P value
Present study	101.20 – 136.07	32	115.88	10.07		
Pal et al [4]	78.70 – 101	62	89	4.38	14.41	< 0.001
Nirmale V et al[8]	98.93 – 147.91	54	128.14	12.48	-4.98	< 0.05
Kanika S et al[6]	----------	20	117.97	12.32	-0.63	> 0.05
Gupta R et al[7]	117.89 – 153.99	50	138.41	9.936	-9.93	< 0.01

Table 4: Comparison of Ischiopubic Index of present study with other populations.

Population	Male				
	N	Mean	SD	Z	P
Present Study	79	100.52	6.33		
Han[9]	115	85.8	4.08	18.23	< 0.001
Australia[9]	89	78	3.76	27.59	< 0.001
Czechs[9]	112	90.4	5.38	11.56	< 0.001
	Female				
Present Study	32	115.88	10.07		
Han[9]	54	98.2	4.25	9.44	< 0.001
Australia[9]	72	92.7	5.99	12.1	< 0.001
Czechs[9]	114	104.3	5.99	6.2	< 0.001

Table 5: Comparison of DP points of various studies (DP = Mean ± 3SD).

STUDY	Male				Female			
	Left		Right		Left		Right	
	DP*	% beyond DP	DP*	% beyond DP	DP*	% beyond DP	DP*	% beyond DP
Present	<84.73	0	< 85.69	**0**	>120.31	**37.5**	**>118. 87**	**37.5**
Kushal KD et al [10]	**<77.81**	**12**	**<87.19**	**38**	**>97.63**	**81.5**	**>96.05**	**90**
Singh S et al[11]	**<82.86**	**15**	**<87.32**	**35**	**>98.17**	**82.5**	**>96.32**	**90**
Sharma GK et al [12]	<77.48	53.33	<77.02	**53.33**	>98.01	**40**	>96.10	**57.5**
Jani CB et al [13]	<82.68	22.85	<80.99	**8.57**	>103.24	**5.5**	>100.23	**16.66**

Demarking points: As shown in Table 1, For ischiopubic index, By DP method, for Mean±3SD, percentage of male hip bones identified were 0% (n=0), and female bones identified were 37.5% (n=12). Comparing with Pal GP et al[3], there was difference in percentage of bones identified as male or female beyond demarking points. Pal GP et al[3] identified more male bones compared to present study.

As shown in Table 5, on comparing the DP points and percentage of bones beyond DP points for male hip bones of present study with other studies it was found that Demarking Point varied from 77.02 to 87.32 in different studies and percentage of bones beyond the DP varied from 0 % to 53.33%. Also on comparing the DP points and percentage of bones beyond DP points for female hip bones of present study with other studies it was found that Demarking Point varied from 96.06 to 120.31 in different studies and percentage of bones beyond the DP varied from 5.5 % to 90%. Although Kushale KD et al [10] observed that DP of Ishciopubic index was the best criteria for discriminating sexual dimorphism in hip bones, it could be said that Ischiopubic indices differ from population to population and hence DPs are different from population to population. Also, nothing could be said for the bones falling in overlapping range.

CONCLUSION

It concludes that there is statistically significant sexual dimorphism in ischiopubic index of male and female hip bones of present study which is in accordance with many other previous studies; also there is statistically significant difference between mean ischiopubic index of present study and other studies of Indian population as well as other than Indian population in both males and females. Also Demarking points method advocated to be an accurate tool in sexual dimorphism has certain limitations.

Numbers of bones identified are variable, We have to create the calculated range by Mean ±3 SD which covers 99.75% observations, because limiting point range is not ideal. DPs is not same. They are different for different studies, location, race etc. There is no any comment about "**overlapping** "range within DPs.

Therefore the present study points towards a need for proper standardization of Mean Ishciopubic index as well as Demarking Point method for individual population, race etc for better identification of male and female hip bones.

ABBREVIATIONS

DP - Demarking Points

SD – Standard Deviation

Conflicts of Interests: None

REFERENCES

[1]. Reddy KSN. The Essentials of Forensic Medicine and Toxicology. 29th edition. Hyderabad: Suguna Devi K; 2010. Chapter 4, Identification;p.55

[2]. Hrdlicka A. Practical anthropometry. Wistar Institute of Anatomy and Biology, Philadelphia 1939. Cited by Weaver DS. Sex differences in the Ilia of a known sex and age sample of fetal and infant skeletons. Am J Phys Anthropology 1980; 52:191-195.

[3]. Pal G.P. Bose S , Choudhary S. Reliability of criteria used for sexing of hip bones. J.Anat.Soc. India 2004;53(2):58-62.

[4]. Jit I, Singh S. The sexing of the adult clavicles. Indian journal of medical research.1966; 54:551-571 Cited by Singh S, Potturi BR. Identification of sex from the hip bone-demarking points. J.Anat.Soc.India 1977; 26(2):111-117.

[5]. Singh IP, Bhasin MK. A Manual of Biological Anthropology. 1st Edition. , Delhi(India): Kamla-Raj Enterprises;2004.p.73-74.

[6]. Sachdeva K, Singla RK, Kalsey G. Role of Ischiopubic index in sex identification from innominate bones in North Indian Population. Int J Anat Res 2014;2(3):515-520.

[7]. Gupta R, Sastya A, Chaturvedi M. Sex determination using Ischiopubic index in Gwalior region of Madhya Pradesh, India (anthropometric analysis). Int J Applied Res 2017;3(7):333-335.
[8]. Nirmale VK, Laeeque M, Diwan CV. Assessment of reliability of various criteria used in adult hip bone sex determination. Int J Anat Res 2016;4(4):3185-3189. DOI : 10.16965/ijar.2016.435.
[9]. Rosenberg K.A late Pleistocene human skeleton from liujiang, china suggests regional population variation in sexual dimorphism in the human pelvis. Variability and Evolution 2002;10:5-17.
[10]. Kushale KD, Bhosal YJ, Shyamkishore K. Identification of the sex of the individual from "Demarking Points" of hip bone. Indian J of Clinical Anatomy and Physiology. October – December 2016;3(4):518-525.
[11]. Singh S, Potturi BR. Identification of sex from the hip bone – Demarking points. Journal of anatomical society of India 1977;26(2):111-117.
[12]. Sharma GK , LaL M, Gurmukh J, S. Lal. Sexual identity of human hip bones from Washburn ischiopubic index. JFMT 1999;2(1):13.
[13]. Jani CB, Gupta BD, Gohil DV, Singel TC. Washburn ischiopubic index: an important tool to differentiate sex of a human hip bone. JFMT 2003;25(1): 5,6,21.

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