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Original Research Article

CHILOTIC INDEX- A STRONG DETERMINANT IN STUDYING SEXUAL DIMORPHISM OF DRIED HIP BONES IN THE POPULATION OF NORTH ANDHRA PRADESH

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ABSTRACT

Aims and Objectives: To study the sexual dimorphism of dried human hip bone with respect to chilotic line and chilotic index (CI) and finding a cut off value for the chilotic index that will be accurate for identification of sex in the human hip bone.

Materials and Methods: The study was undertaken with a sample size of 44 adult human dried hip bones from the department of Anatomy GVP.I.H.C & MT, Visakhapatnam, Andhra Pradesh. The Chilotic line (sacral segment and pelvic segment) was measured using a Vernier calliper and chilotic index was calculated.

Results: The chilotic index in male hip bones fall in the range of 102.77mm-139.46mm with a mean value of 118.32mm and for females it lies in the range of 61.63mm – 98.17mm with a mean value of 84.84mm. This finding is statistically significant with p-value = <0.001.

Conclusion: The total chilotic line in males is longer than in females and a cut off value of 100.48 is statistically 100% correct in identification of a male and a female hip bone.

KEY WORDS: Chilotic Line, Chilotic Index, Ilium, Dimorphism, Sex Determination.

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INTRODUCTION

Sexual dimorphism refers to the difference between male and female in regard to their size and appearance. In forensic and human anthropology biological sex determination remains challenging. It is one of the most important determinants to be made from undocumented human remains. Hip bone is highly dimorphic and in this regard therefore gains importance.

Hip bone is considered as the most reliable sex indicator in the human skeleton [1]. Sexual differences in adults are divisible into metrical and non-metrical features, of which the metrical values of a bone are highly accurate [2]. There is no standard formula for a metrical data because bones are gender-specific and population-specific. Moreover, different population further differ with regard to body built of a person and degree of sexual dimorphism and therefore a single data cannot be applied universally. Therefore with this study an attempt was made to calculate a cut off value for the chilotic line that will be accurate for identification of sex from a hip bone in any given population.

MATERIALS AND METHODS

For this study a sample of 44 adult human dried hip bones (22 male and 22 female) were taken from the Department of Anatomy GVPIHC & MT, Visakhapatnam, Andhra Pradesh. The bones were of unknown sex with no pathological defects. Gender of the bone was assessed through the non-metrical parameters and all the samples were studied morphologically. Ethical clearance was issued from the institutional ethical review committee before the initiation of the study.

Inclusion criteria:

1. Undamaged bones
2. Bones with complete ossification.
3. Bones with no pathological deformity.

Exclusion criteria:

1. Damaged bones
2. Bones having artefacts.
3. Bones of infants and children.
4. Bones with congenital anomalies.

The total sample taken was 44 (n =44) by using the sample size formula

$$n \geq \frac{\left(Z_{1-\frac{\alpha}{2}}+Z_{1-\beta}\right)^2\left(\sigma_1^2+\sigma_2^2\right)}{(\mu_1-\mu_2)^2}$$

Where,

Z =standard normal variate

Alpha =type 1 error

Beta= type 2 error

u1, u2= mean of pelvic and sacral segment of chilotic line.

O1, O2 = standard deviations of the mean in male & female.

All bones were assessed for the metrical parameters like chilotic line and chilotic index. Chilotic line consists of two components i.e. the line extending from iliopectineal eminence to the nearest point in the anterior auricular margin is the pelvic segment and the line from the anterior auricular margin to the iliac crest is the sacral segment. (figure1)

The following metric parameters were taken and statistical calculation was done:

1. Pelvic segment of the chilotic line.
2. Sacral segment of the chilotic line.
3. Chilotic index [CI= sacral segment/ pelvic segment x 100]
4. Mean.
5. Standard deviation.
6. T-test calculation and P-value was also done to establish the significance of the study.
7. Cut-off value for the chilotic line.

The statistical analysis of the data was done by using SPSS version 22. All measurements were recorded in millimetre and entered in the MS Excel work-sheet.

Fig. 1: showing chilotic line and its two components i.e. AB= the line extending from iliopectineal eminence to the nearest point in the anterior auricular margin is the pelvic segment and BC= the line from the anterior auricular margin to the iliac crest is the sacral segment.

RESULTS

The pelvic segment of male hip bones fall in the range of 45.91mm-60.23mm, with the mean value of 53.51mm whereas the pelvic segment of female hip bones ranges between of 55.89mm – 71.60mm with mean value of 63.91mm (shown in table 1).The sacral segment t of male hip bones fall in the range of 57.68mm-71.11mm, with the mean value of 63.06mm whereas as the sacral segment of female hip bones lies in the range of 42.93mm – 64.92mm with the mean value of 53.97mm (table 2).

Table 1: Comparison of pelvic segment of chilotic line in male and female hip bone.

Variable	Gender	N	Minimum	Maximum	Mean	SD	t-value	P-value
PELVIC SEGMENT	Female	22	55.89	71.6	63.91	4.61	8.42	<0.001
	Male	22	45.91	60.23	53.51	3.51		

Table 2: Comparison of sacral segment of chilotic line in male and female hip bone.

Variable	Gender	N	Minimum	Maximum	Mean	SD	t-value	P-value
SACRAL SEGMENT	Female	22	42.93	64.92	53.97	5.01	6.95	<0.001
	Male	22	57.68	71.11	63.06	3.54		

The chilotic index in male hip bones fall in the range of 102.77mm-139.46mm, with the mean value of 118.32mm and in females it lies in the range of 61.63mm – 98.17mm with the mean value of 84.84mm (Table 3). This finding is statistically significant with p-value = <0.001.

Table 3: Comparison of chilotic Index in male and female hip bone.

Variable	Gender	N	Minimum	Maximum	Mean	SD	t-value	P-value
CHILOTIC INDEX	Female	22	61.63	98.17	84.84	9.59	11.26	<0.001
	Male	22	102.77	139.46	118.32	10.11		

Fig. 2: Comparison of chilotic Index in male and female hip bone.

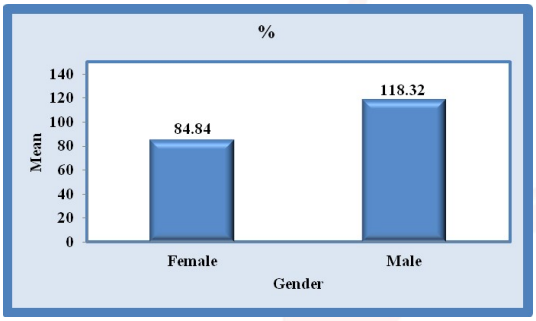

Table 4 and 5 describes the cut-off value of pelvic and sacral segments respectively. Table 6 shows the interpretation of Chilotic Index, which describes that "a cut off value of 100.48 is 100% correct in identification of sex of a hip bone even if it is available in fragments".

Table 4:

PELVIC SEGMENT, cut off value = 57.68			
Observed	Predicted		
	Gender		Percentage Correct
Gender	Female	Male	
Female	18	4	81.8
Male	1	21	95.5
Overall Percentage			88.6

Table 5:

SACRAL SEGMENT, cut off value = 58.84			
Observed	Predicted		
	Gender		Percentage Correct
Gender	Female	Male	
Female	19	3	86.4
Male	3	19	86.4
Overall Percentage			86.4

Table 6:

CHILOTIC Index, cut off value = 100.48			
Observed	Predicted		
	Gender		Percentage Correct
Gender	Female	Male	
Female	22	0	100
Male	0	22	100
Overall Percentage			100

DISCUSSION

A review of literature showed that not much study is available in the population in context to the metrical data on chilotic line (pelvic and sacral segment) and chilotic index. Therefore the present study is undertaken to define a cut off value for the above parameter so that bone identification can be easily done even if it is available in fragments [3].

Study by Ahmed MM in Karnataka region showed mean value of pelvic segment was 63.31mm in males and 54.33 mm in females while the sacral segment was 62.0 mm in males and 50.35 mm in females and Chilotic index was 116.30 in males and 110.5 in females [4]. Charnalia et al showed in their study found that in the south Indian population the mean value of pelvic segment was 47.14mm in males and 59.90 mm in females while the mean value of sacral segment was 65.72 mm in male and 56.74 mm in females and Chilotic index was 112.86 and 115.64 in males and females respectively [5].

In the present study, we found the mean value of pelvic segment and sacral segment along with the mean value of CI of males is 53.51 mm, 63.06 mm and 118.32mm, respectively and in females the same parameters were found to be 63.91 mm, 53.97 mm and 84.84 mm respectively. We defined a cut off value for chilotic index is 100.48. Thus bones with a chilotic index above 100mm can be defined as a male hip bone with 100% accuracy. The present study is compared with previous studies as shown in the table 5. [6, 7, 8]

Table 7: Comparison between the mean value of pelvic segment, sacral segment and Chilotic index of present study with previous studies.

	Pelvic segment (mm)		Sacral segment(mm)		Chilotic Index	
	Male	Female	Male	Female	Male	Female
Derry	52.8	55.7	71.2	61.3	136.1	110.8
Davivongs	45.91	58.23	64.01	56.74	129.26	98.96
Charnalia	47.14	59.9	65.72	56.74	112.86	115.64
Sarangee et al	54.3	60	62	50.35	116.3	110.5
AhmedMM	54.3	63.31	62	50.35	116.3	110.5
Present study	53.51	63.91	63.06	53.97	118.32	84.84

CONCLUSION

The present study shows that the total chilotic line in male is longer than in female hip bone.

So a significant difference among the male and female chilotic index can be determined by a cut off value of 100.48 which is statistically 100% correct in identification of sex in a hip bone. So bones with a chilotic index above 100mm can be defined as a male hip bone with 100% accuracy .Thus, the sex of the Hip bone can be assessed up to about 97% confidence with the help of "Chilotic line" and "Index" only.

Conflicts of Interests: None

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