ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 11, pp.75557-75560, November, 2018

DOI: https://doi.org/10.24941/ijcr.32915.11.2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

CHILOTIC LINE AND OTHER NON-METRIC MORPHOMETRIC MEASUREMENTS AS GENDER DETERMINANTS. A STUDY OF DRY HUMAN ADULT HIP BONE IN SOUTH INDIAN POPULATION

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ARTICLE INFO

Article History:
Received 19th August, 2018
Received in revised form
26th September, 2018
Accepted 18th October, 2018
Published online 30th November, 2018

Key Words:
Innominate Bone, Sex Determination, Ossified, Chilotic Line.

ABSTRACT

Innominate bone or the hip bone is a large and irregular bone. Determination of gender and outcome of normal delivery are main study area that the bone helps in, attributing to its irregularity and variables it serves as an interesting and yielding by many variables. It is a bone of interest from anatomical, anthropological and forensic fields. This study is aimed to find out the sex from an intact full adult ossified hip bone in South Indian population.

Citation: Dr. Pranu Chakravarthy and Dr. Shifan Khanday. **2018.** "Chilotic line and other non-metric morphometric measurements as gender determinants .A study of dry human adult hip bone in South Indian population.", *International Journal of Current Research*, 10, (11), 75557-75560.

INTRODUCTION

Ossa Extremitatis Inferioris, Os Coxaeor in nominate bone are the names given to the hip bone. The hip bone is a large, flattened, irregularly shaped bone, constricted in the center and expanded above and below. It meets its fellow on the opposite side in the middle line in front, and together they form the sides and anterior wall of the pelvic cavity. It consists of three parts, the ilium, ischium, and pubis, which are distinct from each other in the young subject, but are fused in the adult; the union of the three parts takes place in and around a large cup-shaped articular cavity, the acetabulum, which is situated near the middle of the outer surface of the bone. The ilium, so-called because it supports the flank, is the superior broad and expanded portion which extends upward from the acetabulum. The ischium is the lowest and strongest portion of the bone; it proceeds downward from the acetabulum, expands into a large tuberosity, and then, curving forward, forms, with the pubis, a large aperture, the obturator foramen. The pubis extends medial ward and downward from the acetabulum and articulates in the middle line with the bone of the opposite side: it forms the front of the pelvis and supports the external organs of generation (Gray's anatomy). Gender determination is considered as one of the essential parameters in forensic anthropology casework, and requires foremost consideration in the examination of skeletal remains.

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It is possible to determine the sex by visual examination of the hip bone as reported by Asala *et al* (1998). The sexual dimorphism of hip bone is a special adaptation in the females for childbearing. Therefore, awareness of the average dimensions of the hip bone in both sexes will help in detection of sex by forensic experts disputed cases. If the sex of unknown skeleton is accessed correctly, then further investigations are likely to be more accurate and separate male and female standards may be then used for estimation of age (Asala, 1998). There is natural anatomical variation to set norms within each sex. These variations are also affected by factors like genetic, ethnic, environment and culture (Leong, 2006).

MATERIAL AND METHODS

80 hip bones of unknown gender were chosen. Unpaired unknown of sex human ossified adult hip bones were included in this study. Bones included are from the Anatomy department of Sri Ramchandra institute of higher education and research (DU), Chennai. Fully ossified, intact, well preserved bones are included in this study. All hip bones were adult type and without any signs of erosion.

Institutional ethics committee reference number: IEC-NI/18/JUL/65/43

Following parameters were studied:

Inclusion criteria: Healthy hip bones.

Exclusion criteria: The hip bones that have been eroded, malformed and deformed

Osteometric parameters: Gender identification of the hip bones was done on apparent and visible features like angle of grater sciatic notch, Ischiopubic ramus, shape of Obturator foramen, prominence of Pre- auricular sulcus and Acetabular diameter. According to the above mentioned non-metrical parameters sex of the hip bone can be determined by the presence or absence of these characters, hip bones were classified as female bones due to the presence of PAG, the trait only found in female hip bones. The following characteristic were found with the increasing order of their presence in the hip bone to classify male or female hip bone, (1) MOC, (2) PR, (3) IPR aspect, (4) PT, (5) para AG, (6) CA, and (7) PAG. Accordingly, 40 bones were classified as male hip bones and 40 hip bones were classified as female hip bones. Only fully ossified adult hip bones were included in the present study. Hip bones showing wear and tear, any fracture, or pathology were excluded. The metrical parameter taken under study is CI. Using Vernier calipers, the chilotic line was measured (Figures d, e).

The CI is calculated as follows: CI =Sacral segment/ Pelvic segment × 100. Non metric studies like weight are taken in grams by an electronic weighing machine (Fig. 1). Metric method studies are done by putting the bone over the flat surface of the table against the wall and a osteometric board on the other side. Measurements taken are with the help of a metallic scale in cm.

The parameters included in the study:

- **Weight:** Bones are weighed by an electronic weighing machine.
- **Length:** Maximum distance between iliac crest and ischium. (Fig. 2)
- **Width:** Maximum distance between anterior and Posterior ends of iliac crest (Fig. 3)
- Coxal index, calculated by the formula Width of hip bone / Length of hip bone × 100

RESULTS

Out of the 80 hip bones ,40 are male and 40 females. The mean weight of male hip bone is 137.95gm. The mean of length for male hip bone 20.25cm and the mean width for female hip bone 18.46cm. The Coxal index for males was 73. The mean weight of female hip bone is 111. 77gm.The mean length 18.46cm and the mean width of 14. 58cm.TheCoxal index for females was 78.98. The pelvic segment of the male hip bones falls in the range of 45-65mm, with the mean value of 54.47 mm, whereas the pelvic segment of the chilotic line for females lie in the range of 57.1-101.9 mm, with the mean value of 62.7 mm. While P and t values were 0.0001 and 5.8177, respectively. The sacral segment of male hip bones falls in the range of 51-73mm, with the mean value of 63mm, whereas the sacral segment of the chilotic line for females lie in the range of 41-58mm, with the mean value of 48.67mm. While P and t values were 0.0001 and 10.8844, respectively. The CI for male lies in the range of 87.9-155mm, with the mean value of 115.7 and for females the CI lies in the range of 57.1-101.9mm, with the mean value of 77.6. While P and t values were found to be 0.0001 and 7.8437, respectively.

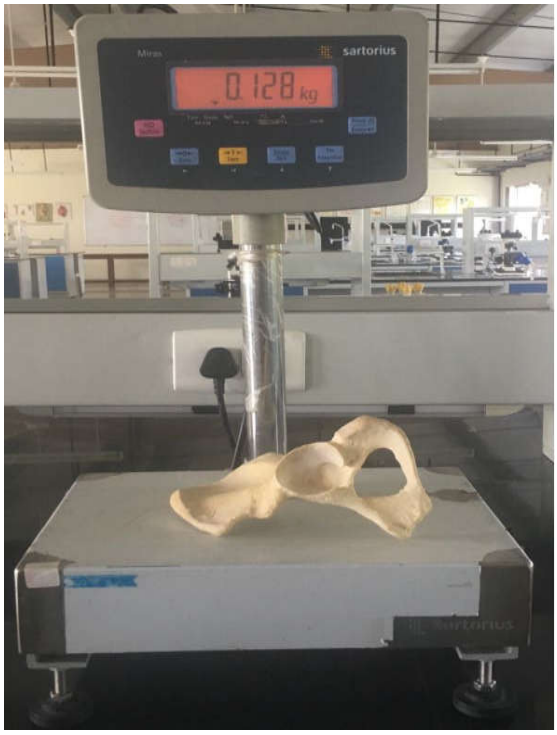

Fig a: Measurement of weight of hip bone.

Fig b. Measurement of length of hip bone

Fig c. Measurement of width of hip bone

Fig d: Measurement of sacral segment

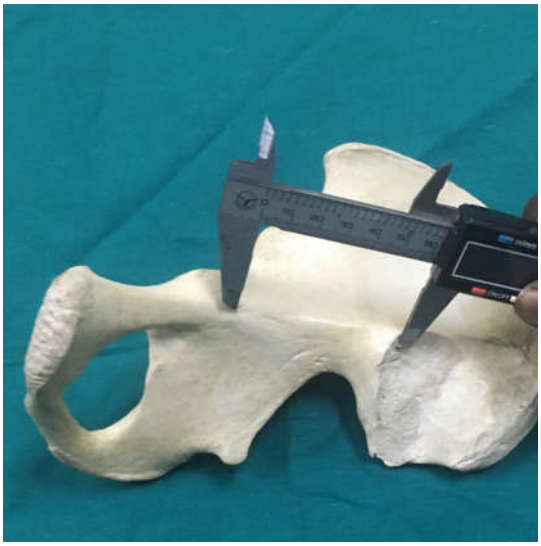

Fig e: Measurement of pelvic segment

Table 1.Measurements of Weight (gm) length(cm),width (cm), Sacral segment(mm)t and pelvic segments(mm)of Male Hip Bone

Weight (gm)	Length(cm)	Width(cm)	SACRAL SEGMENT (mm)	PELVIC SEGMENT(mm)
138	18.5	14	69	55
123	19.4	14.2	53	60
131	20.8	15.3	68	58
125	20.4	14.5	51	58
117	20.1	14.4	70	55
175	20.5	14.7	64	55
130	20.1	15.7	71	53
141	21.5	15	73	64
146	22	16.5	62	49
125	20.4	14.5	56	60
118	20.2	14.4	52	54
174	20.4	14.7	61	56
130	20.1	15.7	58	58
122	19.3	14.2	59	54
130	20.7	15.3	62	40
136	20.3	14.6	60	52
127	21	14.3	63	57
160	21.5	14.5	72	53
140	20	14.7	62	50
152	18.9	15	63	45
138	21	14.2	65	49
143	19.8	14.5	61	54
139	19.6	15.2	59	51
128	21.1	14	72	53
134	20.6	14.6	68	54
160	21.2	13.9	75	53
137	20.5	15	73	52
146	18.8	14.6	60	58
126	19	14.3	44	53
130	20	14.5	63	60
130	20.3	15.5	61	54
147	21.5	15.8	64	52
144	18.9	14.6	68	59
132	20.2	15.2	61	54
142	21	14.9	61	56
130	20.3	15.2	62	54
144	19	14.7	64	51
152	20.2	15.1	60	62
135	19.8	14.9	68	55
141	21.3	14.8	63	59

DISCUSSION

Anatomists can give expert opinion regarding sex and age of the individual from the skeletal remains found under suspicious conditions. In medico legal cases, there is necessary to determination of sex and age from the available intact bones or skeletal remains. A general rule is male bones are heavier and more massive than female bones.

In this study also, the mean weight of male bone is 137.95gms which is more than the mean weight of female which is 111.77gms. Mean values of various parameters from different regions show significantly different values and therefore demarking point (DP) has to be calculated. The Coxal index in present study is 71.56 on right side and 70.85 on left side. The values are consistent with values taken by Garson in Andamanese, Peruvian, New Caledonian and Savage Islander

Table 2. Measurements of Weight (gm) length(cm),width (cm), Sacral segment(mm) and pelvic segments(mm)of Female Hip Bone.

WEIGHT(gm)	LENGTH(cm)	WIDTH(cm)	SACRAL SEGMENT (mm)	PELVIC SEGMENT (mm)
99	18.5	15.7	45	63
117	18.8	14.5	53	63
136	17.9	14.5	50	68
113	19.7	14.3	51	55
108	18	14.6	40	70
105	18.1	14.5	58	63
116	18.8	14.5	42	62
136	17.9	14.5	54	72
112	19.7	14.3	55	69
109	18	14.6	43	64
135	17.8	14.5	52	67
112	18.2	14.4	51	77
110	18.3	14.3	57	74
104	17.6	14.6	58	74
100	17.8	14	46	72
98	17.9	14.2	42	64
110	18	14.1	57	67
106	18.4	13.9	54	60
95	20	14.6	51	64
126	19.1	14.2	44	60
111	18.7	15	45	63
120	18.5	14.6	48	54
104	19	15.2	42	70
113	17.5	14	41	53
123	19.2	15.6	44	54
89	17.8	14.7	46	62
102	18.8	14.1	49	68
126	19.1	14.2	41	58
111	18.7	15	44	53
120	18.5	14.6	50	60
104	19	15.2	44	65
113	17.5	14	46	58
123	19.2	15.6	50	59
108	18.1	14.1	55	54
112	19.8	15	47	56
109	18.6	14.3	52	60
103	18	14.6	49	51
114	17.6	15.3	51	62
121	19.2	14.5	53	61
98	17.3	14.8	47	59

populations. In this study, it is seen that the CI differentiates sex except in the range of 85-105 where overlapping values is seen in both sexes, therefore the probability of the bone belonging to male is higher if the CI is more than 105 and to females if the CI is <85.

Conclusion

Generally male bones are heavier then female bones. The mean weight of hip bone on right side is less than left side in both sexes. The mean length & width of hip bone on left side is also more than right side in both sexes. The values are similar to other Indian studies. The Coxal index in present study is 73 for males and 78.98 for females. From this study, it is concluded that the total chilotic line in males is longer than in females. The CI for male lies in the range of 87.9-155mm, with the mean value of 115.7 and for females the CI lies in the range of 57.1-101.9mm, with the mean value of 77.6. While P and t values were found to be 0.0001 and 7.8437, respectively therefore from this study it is seen that average values of CI are more in males then in females. From the present study, it is also seen that few hip bones about 12% in females and 23% in males have overlapping values of CI lying in the range of 85-105, therefore from the present study of CI about 77% of hip bones were accurately classified as male hip bones and about 88% of hip bones were classified as female hip bones, from the present study, it is also concluded that the bones having the values of CI<85 belongs to females and the hip bones having the values of CI above 105 belongs to males.

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