The Sex determination by Posterior Border Of Adult Human Hip Bone

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Abstract : The sex determination of individual is greatly useful in Anatomy, Archeology & Forensic departments. The hip bone is most reliable bone to determine the sex of individual. A biometrical study of posterior border of 100 adult human hip bones has been done. With the use of osteometric board & triflanged stainless steel caliper, various parameters were measure. Various variables of posterior border of hip bone were calculated by using range, mean, S.D. & P value. In all parameter the arch PB (arch of posterior border), the total angle of greater sciatic notch & the posterior angle of greater sciatic notch gives statistically significant differences between the means related to sex. Above three parameters were highly significant to determine the sex by posterior border of hip bone. The mean value of the arch PB of male was high than female. The mean value of posterior angle of greater sciatic notch was 2.5 times higher in female. We had also measure demarking point (DP) for above three variables. The demarking point gives 99.75% accurate data which were measure by adding & subtracting 3xS.D.from the means. In present study the demarking point for arch PB was >143mm in male & <126mm in female, total angle of greater sciatic notch was $<46^0$ in male & $>86^0$ in female & posterior angle of greater sciatic notch $<11^0$ in male & $>25^0$ in female. In medicolegal cases where 100% accuracy is required, the use of demarking point is preferable. This study is useful for carrying out medico legal examination of bones, cephalopelvic proportions in obstetric cases, for academic studies in Anatomy & for anthropological examination of skeleton, radiological study of pelvis & for archaeological examination of skeleton.

Key-words: Arch of posterior border of hip bone, total angle of greater sciatic notch, Posterior angle of greater sciatic notch

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INTRODUCTION: It has become easy and perfect to judge the sex if complete skeleton from one racial group is brought, provided individual under examination has passed the age of puberty. The hip bone is the most reliable skeleton in sexual dimorphism[1]. The pelvic cavity is long & narrow in male & wide & short in female because of parturition. Also it is found that sex had a great influence on the dimensions of greater sciatic notch & its importance is more emphasized during pregnancy[2,3,4].

Previous studies by using the hip bone were based on sex determination on following parameters: acetabulum, obturator foramen, greater sciatic notch, ischiopubic rami, chelotic index, arcuate index & body of pubis. In this study we measured various parameters of posterior border of hip bone including angles of greater sciatic notch to decide the sex, & also morphological changes on posterior border of hip bone because of sexual dimorphism. The total angle & posterior angle of greater sciatic notch were very useful to determine the sex[5].

The identification point can give wrong result even in the same area when applied to unknown case. So instead of using identification point for each highly significant parameter, we used demarking point by adding & subtracting 3xS.D. from the mean value of each highly significant parameter[6]. It includes all the cases of any given region so demarking point is identified sex virtually with 100% accuracy. However it is necessary to determine the demarking point for each race & even for the different regions of a similar population[7].

MATERIAL AND METHODS: Hundred dry normal adult human hip bones of known sex were taken for

study from various medical colleges of Gujarat. They were undamaged & with no alter pathology. There were 42 male & 58 female hip bones available.

In this study following variables on the posterior border of hip bone were measured. (1) the maximal distance of posterior border notch i.e., distance from the posterior superior iliac spine to the superior border of the ischial tuberosity (PSIS-IT), (2) distance from the posterior superior iliac spine to ischial spine (PSIS-IS) (3) the maximal width of the posterior superior iliac spine to posterior inferior iliac spine (PSIS-PIIS) (4) the distance from posterior inferior iliac spine to ischial spine (PIIS-IS) (5) the distance from posterior inferior iliac spine to ischial tuberosity (PIIS-IT) (6) the arch of posterior interspinous notch i.e. the length of the border between the posterior superior iliac spine & the posterior inferior iliac spine (arch PIN), (7) the length of notch between posterior inferior iliac spine to ischial spine (arch PIIS-IS), (8) the arch of posterior border of hip bone (arch PB), (9) the total angle of greater sciatic notch & (10) the posterior angle of greater sciatic notch.

For measurement of all variables a scale, an osteometric board, an inextensible thread, protractor & a pencil were used. For measurement of distances, hip bones were placed vertically on osteometric board & distances were taken in mm by scale. Same as for arch PIN, arch PIIS-IS, arch PB, thread was applied to arch of posterior border of hip bone at above mentioned points & then length of thread was taken by scale in mm.

To measure the angle of greater sciatic notch the pyriformis tubercle was taken as the posterior point (B), the tip of ischial spine was taken as the anterior point (A) to make width(AB) & third point (C) marked at maximum depth of notch with use of triflanged stainless steel caliper, & marked all of above on paper[5]. Then draw the perpendicular line from point (C) to width AB & meeting point is marked as (O). Now draw triangle ABC on paper & also draw line OC vertical to AB width. After construction the triangle ABC & OC, <ACB noted as the total angle & <BCO noted as posterior angle of greater sciatic notch[5]

Figure-1

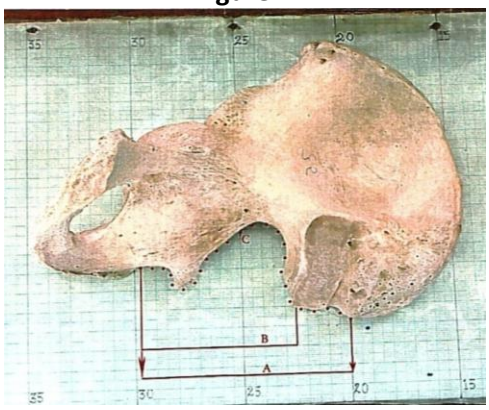

Figure-1: diagram showing variable studied, A- dist. PSIS-IT, B- Dist. PIIS-IT, C- Arch PB

Figure-2

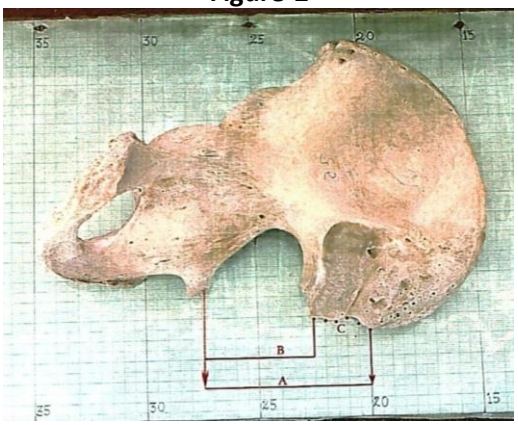

Figure-2: diagram showing variable studied, A-Dist. PSIS-IS, B- Dist. PIIS-IS, C- Arch PIN

Figure-3

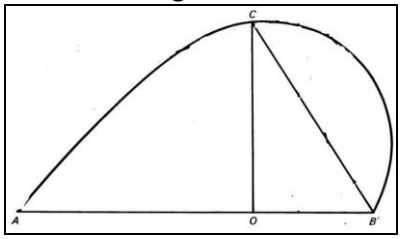

Figure-3: diagram showing widening of posterior segment of greater sciatic notch resulting wide <BOC. A- tip of ischial spine, B- pyriformis tubercle, C- marked maximum depth of notch, <ACB- total angle & <BOC – posterior angle.

For each variable, its mean, S.D., maximum & minimum values & P values are calculated. Also demarking point is calculated by adding & subtracting 3SD to & from the mean value of each highly significant measurement.

RESULTS:

Table:1 comparison of values obtained from various variables in relation to sex

variables	Range mm (male)	Range mm (female)	Mean (male)	Mean (female)
Dist. PSIS-PIIS	18-41	18-34	25.14	24.48
Dist. PIIS-IS	38-58	44-62	50.47	51.25
Dist. PSIS-IS	64-88	62-89	75.61	75.74
Dist. PIIS-IT	53-75	48-79	62.95	63.06
Dist. PSIS-IT	79-103	71-101	86.97	85.44
Arch PIN	22-44	24-37	30.33	30.32
Arch PIIS-IS	76-99	72-103	88.47	90.12
Arch PB	125-147	111-136	138.97	124.87
TOTAL ANGLE	480-800	600-950	65.42	77.36
POST. ANGLE	80-240	170-450	13.28	30.65

Table-1 shows the comparison of various variable of posterior border of hip bone in relation to sex with its normal range & its mean value.

Table-2: P value of various variables of posterior border of hip bone in relation to sex

variables	Male Mean± SD	Female Mean± SD	P value
Dist. PSIS-PIIS	25.14±4.33	24.48±3.17	0.414
Dist. PIIS-IS	50.47±4.16	51.25±4.54	0.382
Dist.PSIS-IS	75.61±4.96	75.74±5.73	0.906
Dist. PIIS-IT	62.95±5.13	63.06±6.16	0.925
Dist.PSIS-IT	86.97±5.37	85.44±6.58	0.219
Arch PIN	30.33±3.93	30.32±3.44	0.989
Arch PIIS-IS	88.47±5.90	90.12±5.82	0.167
Arch PB	138.97±4.39	124.87±6.04	0.000
TOTAL ANGLE	65.42±7.10	77.36±10.31	0.001
POST. ANGLE	13.28±4.10	30.65±6.35	0.000

Table-2 shows p value of variants of posterior border of adult human hip bone. This shows that arch PB, total angle of greater sciatic notch & posterior angle of greater sciatic notch has $P<0.05$ which means these parameters are highly significant amongst all.

Table-3 Demarking point of highly significant variables in relation to sex

variable	Demarking point (D.P.)
Arch PB	
Male	>143mm
Female	<126mm
Total angle	
Male	<460
Female	>860
Posterior angle	
Male	<110
Female	>250

Table 3 shows the demarking point of arch PB was >143 in male & <126 in female, of total angle of greater sciatic notch was $<46^0$ in male & $>86^0$ in female & of posterior angle of greater sciatic notch was $<11^0$ in male & $>25^0$ in female.

DISCUSSION: The pelvic cavity of male is long & narrow because of more weight transmission & of female is wide & short for parturition. So male hip bone has more height & female hip bone has wide greater sciatic notch.

In all variables of posterior border of hip bone to determine the sex, the lowest probability of error ($P<0.01$) for giving statistically significant difference between the means related to sex is shown by arch of posterior border of hip bone (i.e. form posterior superior iliac spine to superior border of ischial tuberosity), total angle of greater sciatic notch & posterior angle of greater sciatic notch.

In our study the arch PB in male varied from 136mm-147mm & in female it varied from 111mm-135mm. The mean value of arch PB was 138.47±4.39 in male & was 124.87±6.04 in female. In study of Issac[9] the mean value of arch PB were 131.33±9.88 in male & 119.06±14.82 in female which were lower than present study. Though mean

value of male was more than that of female & P value was significant which match with study of Issac[9].

The greater sciatic notch is wider in female than in male[2,3,8]. In relation to above, singh & potturi[5] found that total angle is significantly higher in female (P<0.001). In present study the mean of total angle was 65.42±7.10 in male & 77.36±10.31 in female so mean value of female was significantly higher (P<0.001) than male.

Singh & potturi[5] found that mean value of posterior angle of greater sciatic notch was 2.5 times lower than female with minimal overlapping in their ranges, resulting in correct identification of 92-100% of all female bones & 75-88% of all male. In present study the mean value of posterior angle was 13.28±4.10 in male & 30.65±6.35 in female, which suggest that mean value of posterior angle in male was near to 2.5 times lower than female. This suggests that widening of greater sciatic notch is more on posterior segment of notch[5].

To identify the sex of bone very accurately, it is not necessary that all parameters have crossed the demarking point. If one parameter of hip bone crosses the demarking point, it determines the sex correctly. It is necessary to find the demarking point for each race & region separately[7]. In present study the demarking point for arch PB was >143mm in male & <126mm, for total angle was $<46^0$ in male & $>86^0$ for female & for posterior angle was $<11^0$ in male while $>25^0$ in female.

Table-4: Demarking point for posterior angle of greater sciatic notch found by Singh & Potturi[5]

	right	**left**
Male	$<57.44^0$	$<60.58^0$
female	$>87.90^0$	$>85.77^0$

So in present study demarking point of posterior angle of greater sciatic notch of female matched with finding of Singh & Potturi[5] (table-4).

The above highly significant parameters of posterior border of hip bone can be used for determination of sex of individual more accurately.

CONCLUSION: Amongst all variables of posterior border of adult human hip bone, the arch of posterior border of hip bone, the total angle of greater sciatic notch & the posterior angle of greater sciatic notch gives statistically significant difference between the mean related to sex (P<0.01). So above three parameters of posterior border of hip bone are very useful criteria to determine the sex of hip bone. By using demarking point of above three parameters, we can judge the sex 100% accurately. The widening of greater sciatic notch in female is more on posterior segment, so the posterior angle of greater sciatic notch is excellent parameter for sex determination.

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