

Determination of Sex of Sacrum in Adult Bangladeshi People by Morphometric Study

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ABSTRACT

Background: Sex determination from bones is of vital importance in anthropological studies and medico-legal cases. Sacrum is one of the bones, which exhibits sex differences. Literature available on this bone shows that not much study has been done in the population of Bangladesh. In the present study, an attempt has been made to test the validity of the parameters that are useful in differentiating male and female sacra. The present study was conducted to see the sexual dimorphism and morphometry of sacrum in adult Bangladeshi people. This study will be useful for anatomists, experts in forensic medicine and physical anthropologist for more accurate sexing of sacra.

Materials and methods: Descriptive, cross-sectional study was conducted in the Department of Anatomy, Chittagong Medical College, Chattogram on 100 dry human sacra of known (Male-46, female-56) sex during January 2014 to December 2014. The measurements included for the study were maximum length, maximum width, mid ventral curved length, transverse diameter of first sacral vertebra, length of ala, maximum length of auricular surface and indices like curvature index, sacral index, corporo-basal index, alar index, index of body of S1, auricular index were calculated and statistically analyzed.

Results: In the present study the male sacrum showed significantly higher values for ventral straight length, ventral curved length, transverse diameter of S1 and antero-posterior diameter of S1 than the female sacrum, while the female sacral index showed higher value compared with the values of male.

Conclusion: From the above parameters and indices in the present study revealed demarking points for each have statistical significant role in determining the male and female sacrum.

Key words: Demarking points; Large bone; Morphometric study; Sacral index; Sex of sacrum.

Introduction

The sacrum is a large triangular bone formed by fusion of five sacral vertebrae usually. It forms caudal end of vertebral column and contributes to form postero superior wall of pelvic cavity wedged between two hip bones¹. It supports the erect spine and provides the strength and stability of bony pelvis to transmit the body weight and

also allows mobility in child bearing. The sex classification of a bone is possible with a degree of certainty only when it can be compared to a series of bones of known sex. Otherwise, a female bone could be classified as male when the series to which it belonged was particularly robust². The sacrum has always attracted the attention of the medico-legal experts for establishing its sex, because its contribution to pelvic girdle and associated functional sex differences. Thus sacrum assumes applied importance in determining sex with the help of measurements carried upon it³. Sacrum has been considered amongst ideal bones to determine sex of individual because of its functional morphological variation in both sexes by virtue of its contribution to pelvis⁴.

It has long been customary among anatomists, forensic experts and anthropologists to judge the sex of the skeletal material by non-metric observations. Lately sexual divergence has been based upon actual measurements in different bones. Though sacrum is often considered to be an important bone while dealing with sex differences in skeletal material, there is paucity of metrical data available for this bone⁵. Hence in establishing the personal identity with respect to age, sex, stature forensic experts, anatomists and anthropologists use skeletal materials for giving their opinion⁶. According to Krogmann the degree of accuracy in sexing adult skeletal remains is as follows⁷:

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Entire skeleton	100%
Pelvis as whole	95%
Skull as whole	90%
Pelvis and skull together	98%
Long bones	80%

Materials and methods

100 intact, dry, completely ossified adult human sacra were collected and assessed. The bones were collected from MBBS students of Southern Medical College, IAHS (Institute of Applied and Health Sciences) Chittagong Medical College, Chattogram. Any sacrum with fracture, pathology of wear and tear were discarded. By using digital Vernier caliper and taken measuring tape different measurements were measured. The Demarking Points (DP) of all the parameters, percentage of bones were also measured according to Math S.C⁶. The following parameters of sacrum were measured using digital Vernier calliper according to Kothapalli J et al⁸.

i) Maximum Length of Sacrum: (Anterior straight length-SL) Straight distance from sacral promontory in the mid sagittal plane to the corresponding lowest point on the anterior margin of the sacrum was measured (Figure 1).

ii) Maximum Breadth (Width) of Sacrum: This was measured by taking two points at the upper part of auricular surface anteriorly or lateral most part of alae of sacrum (Figure 2).

iii) Transverse Diameter of the First Sacral Body (TD-S1): It is the maximum transverse diameter of the first sacral body measured by one point on each side of the lateral most point on the superior surface of the body.

iv) Length of Ala: It is measured on both sides by taking one point on lateral most point of superior surface of body of first sacral body and another point on lateral most point of ala. The mean length of two sides is taken as the length of ala of that vertebra.

v) Maximum Length of Auricular Surface (AS): It is the straight auricular length measured on the lateral aspect of sacrum by taking one point on the upper most part of the auricular surface and anterior point on the lower most part of the auricular surface of sacrum.

From above observations the following indices were calculated:

vi) Sacral Index: Maximum width /Maximum Length x 100.

vii) Alar Index: Length of ala/ TD S1 x 100.

viii) Auricular Index: Length of auricular surface/ Width of sacrum x 100.



Figure 1 Maximum length of sacrum is being measured

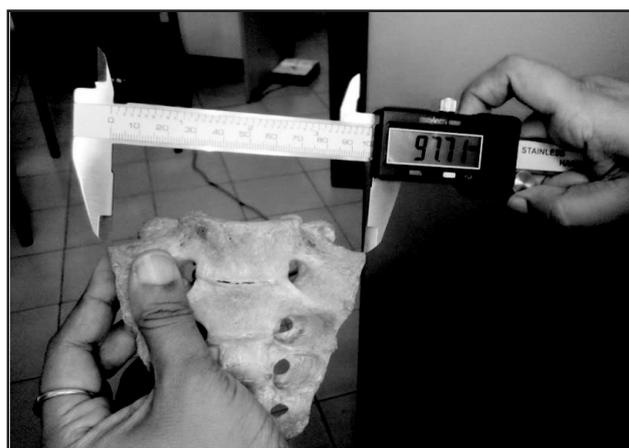


Figure 2 Maximum transverse diameter is being measured

Table I Various parameters of sacrum and their statistical analysis

Sl. Parameters	Sex	Range	Mean	SD value	T	'p' value Mean + 3.5 D	Calculated range	D.P. by D.P.	% of bone identified
1. Length of sacrum (mm)	M	88-121	104.45	7.20	10.186	<0.001	82.85-126.05	>108.85	27.27
	F	78-102	91.09	5.92			73.33-108.85	<82.85	10.71
2. Width of sacrum (mm)	M	83-113	98.43	6.66	3.788	<0.001	78.45-118.41	<87.51	4.54
	F	90-114	103.05	5.18			87.51-118.59	>118.41	0
3. Curved Length of sacrum	M	95-130	110.95	7.89	5.555	<0.001	87.28-134.62	>122.15	4.54
	F	90-120	103.04	6.37			83.93-122.15	<87.28	0
4. Length of ala sacrum (mm)	M	24-41	30.55	4.05	1.318	>0.05	184-42.7	<19.07	0
	F	20-40	31.64	4.19			19.07-44.21+42.7	0	
5. Length of auricular surface (mm)	M	38-90	52.91	7.50	1.971	>0.05	30.41-75.41	>62.58	2.27
	F	40-58	50.61	3.99			38.64-62.58	<30.41	0
6. Tr. Dia of body of S1 vertebra (mm)	M	38-57	44.18	5.23	2.921	<0.01	28.49-59.87	>55.30	4.54
	F	30-50	41.29	4.67			27.28-55.3	<28.49	0
7. A.P dia of S1 vertebra (mm)	M	14-32	27.59	3.29	0.633	>0.05	17.72-37.46	>34.34	0
	F	20-31	27.23	2.37			20.12-34.34	<17.72	0
8. Sacral index	M	86.27-104.34	94.35	4.82	14.523	<0.001	78.89-108.81	<88.94	15.90
	F	100.00-146.15	94.35	4.82	14.523	<0.001	88.94-137.78	>108.81	73.21
9. Curvature index	M	85.00-98.09	93.96	3.66	5.768	<0.001	82.98-104.94	>104.2	0
	F	70.90-98.00	88.63	5.19			73.06-104.2	<82.98	10.71
10. Corporobasal index	M	38.46-54.54	44.91	4.56	4.871	<0.001	31.23-58.59	>54.45	4.54
	F	31.00-55.12	40.35	4.70			26.25-54.45	<31.23	3.57
11. Alar index	M	47.36-95.34	70.16	12.98	1.757	>0.05	31.22-109.1	<38.42	0
	F	32.67-96.77	74.57	12.05			38.42-110.72	>109.1	0
12. Index of body of 1st sacral vertebra	M	48.07-78.94	63.50	7.28	0.882	>0.05	41.56-85.34	<33.35	0
	F	27.08-90.32	65.15	10.60			33.35-96.95	>85.34	1.78
13. Auricular index	M	40.00-66.26	52.74	5.75	2.040	<0.05	35.49-59.99	>76.12	0
	F	27.18-84.95	49.60	8.84			23.08-76.12	<35.49	3.57

This study was approved by Ethical Review Committee of Chittagong Medical College, Chattogram.

Results

While studying the mean values of all parameters, it is observed that the mean values of all parameters except the width and length of ala of sacrum are more in male than female. The mean value of sacral index, alar index and index of body of S1 are higher in females while the curvature index, corporobasal index and auricular index are higher in male.

Discussion

Actually very little data is available to test the validity of the number of parameters described to identify the sex of sacra⁹. The demarking points of various parameters of sacra will help to identify the sex with certainty, which is of paramount importance in medico-legal cases. The mean length of male sacra (104.45mm) which is similar to Singh in Varanasi region (104.96mm) low compared to Mishra in Agra region (107.53mm) but high compared to Davivongs on Australian aborigines (96.52mm)¹⁰. The mean length of female sacra in present study is closely similar to study of Agra and Varanasi region but high compared to Australian aborigines. The mean width of male sacra (98.43mm) in the present study is low compared to Agra (105.34 mm) and Varanasi (105.33mm) region but closely similar to Australian aborigines (98.43mm). Arora examined sacra of Punjab region and showed that maximum breadth of male and female sacrum was 101.94 mm and 114.13mm respectively¹¹. Mean width of female sacra is more than the mean width of male sacra in the present study. The mean curvilinear length of male and female sacra in the present study is 110.95mm and 103.04 mm respectively which is closely similar to Singh's study. The mean values of transverse diameter of S1 of males are higher than females, this supports the general rule i.e. large in males¹². Antero-posterior diameter of male and female sacra of present study falls within the same range, which is close to the values of Agra and Varanasi region population.

The mean sacral index of male falls in dolichoheric group i.e. narrow pelvis (94.35mm) and female sacrum falls in platyheric group i.e. broad pelvis (113.36 mm) in the present study¹³. Female has the greater sacral index than male and the difference was statistically highly significant (<0.001). Similar observations recorded in Agra and Varanasi population. The mean curvature indexes, corporobasal index of male are more than the female sacra and they are highly significant. The same trend is observed in the Agra population. The alar index, index of body of first sacral vertebra are more in female than male sacra which are similar with the study of Agra population.

Conclusion

The present study showed the morphometric study of sacrum of adult Bangladeshi people. Among the parameters, significant differences occur between male and

female sexes are straight length, curved length, width, transverse diameter of S1 vertebra. All are more in case of male except width which is more in case of female. Among the indices, the sacral index is found statistically significant for sexing the sacrum which is more in female sacrum in present study. However not a single parameter could identify sex in 100% of the bones. Hence it can be concluded that sex determination of the sacrum with 100% accuracy is possible only when maximum number of parameters are taken into consideration.

Disclosure

All the authors declared no competing interest.

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