

Study of Sexual Dimorphism in Sacrum Based On Corporobasal Index and Alar Index

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Abstract

Skeleton is an excellent material in living and non-living population for forensic investigation. Sacrum is an ideal bone for determination of sex because it not only reflects general difference between two sexes but shows special adaptation in females for child bearing. It is believed that reliability in identifying female bone is more using alar index and transverse diameter of S1. In our study 100 sacra of both sexes were compared for of Body of First Sacral Vertebra (S1), alar index and corporobasal index. The results show Index of Body of First Sacral Vertebra (S1) in male is 62.53 and in females it is 54.74 Corporobasal Index in male is 57.89 and in females it is 52.80. One way ANOVA shows 0.001 significance suggesting statistically highly significant difference in male and female for both Corporobasal index and Index of Body of First Sacral Vertebra (S1). Alar Index in male is 66.68 and in females it is 71.21. One way ANOVA shows f value as 2.715 which is non-significant. The results show that Index of Body of First Sacral Vertebra (S1) and Corporobasal Index are more reliable parameters than Alar index for determination of sex of Sacrum.

Keywords: Sacrum; Sexual Dimorphism; Parameters; Index of Body of First Sacral Vertebra (S1); Corporobasal Index.

Introduction

The sacrum is a large, triangular bone of pelvis. It is present on the postero-superior wall of the pelvic cavity, wedged between the two innominate bones. It is formed by fusion of five vertebrae [1]. Sexual dimorphic characters can be studied both morphologically and metrically in the determination of personal individuality from adult human skeletal remains.

Determination of sex is an integral first step in the development of the biological profile in human osteology. Sex determination is necessary to estimate age, ancestry and stature. The developmental age changes are different in male and female bones

including sacrum [2]. The pelvic girdle is the most accurate area to determine sex and methods using the pelvic girdle tend to make successful predictions in 90 to 95 percent of individuals [3].

The sacrum has always attracted the attention of medicolegal experts for establishing the sex due to its contribution to the pelvic girdle and associated sex differences, which are augmented due to reproductive functions, mainly influenced by sex hormones [4]. Accurate estimation of sex from an unidentified human skeleton can be difficult when incomplete remains are encountered. This research provides a novel technique for determining sex from the human sacrum using a discriminate function analysis of geometric morphometric data.

Material and Method

The present study was carried out at Department of Anatomy, Government medical college Aurangabad and MGM medical College, Aurangabad. Approval was obtained from Institutional Ethical committee.

Written permission was taken for collection of 100 sacra of both the sexes from HOD Department of Anatomy, Govt. Medical College and MGM medical

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College, Aurangabad. Non ossified and fragmented sacra were excluded from the study.

The sliding Vernier caliper with scale graduated from 0 to 150 mm of Mitutoyo absolute digimatic company, made in Japan was used to measure minimum Sacral width, maximum Sacral width, transverse diameter of body of S1. Length of alae of sacrum was measured by standard metallic scale.

1. *Maximum sacral width*: The straight distance between two points at the lateral most part of alae of sacrum.
2. *Minimum sacral width*: Minimum transverse distance measured midpoint of fourth and fifth sacral vertebra, near the apex.
Width of sacrum was calculated by taking average of maximal and minimal sacral width.
3. Transverse diameter of the body of the first sacral vertebra was measured by taking one point on each side of the lateral most point on the superior surface of the body of first sacral vertebra.
4. Antero-posterior diameter of body of the first sacral vertebra: It is the maximum possible diameter of body of first sacral vertebra taking one point on the antero-superior border and other on the postero-superior border and was measured by Vernier caliper.
5. Length of alae It was measured on both sides by taking one point on lateral most point of superior surface of body of first sacral vertebra and another point on lateral most point of ala. The mean length of two sides is taken as length of ala of that vertebra.

6. *Indexing*: The Index of body of 1st Sacral vertebra, Alar index and Corporo-basal index were calculated by formulas [3] given below-

1. Index of body of 1st Sacral vertebra =

$$\frac{\text{AP Diameter of body of S1} \times 100}{\text{Transverse dia. of body of S1}}$$

2. Corpora-basal index =

$$= \frac{\text{Transverse diameter} \times 100}{\text{Width of Sacrum}}$$

3. Alar index =

$$\frac{\text{Length of ala} \times 100}{\text{Transverse diameter of body of S1}}$$

The parameters and indices were analysed statistically by using SPSS 19 software and compared for multivariate analysis.

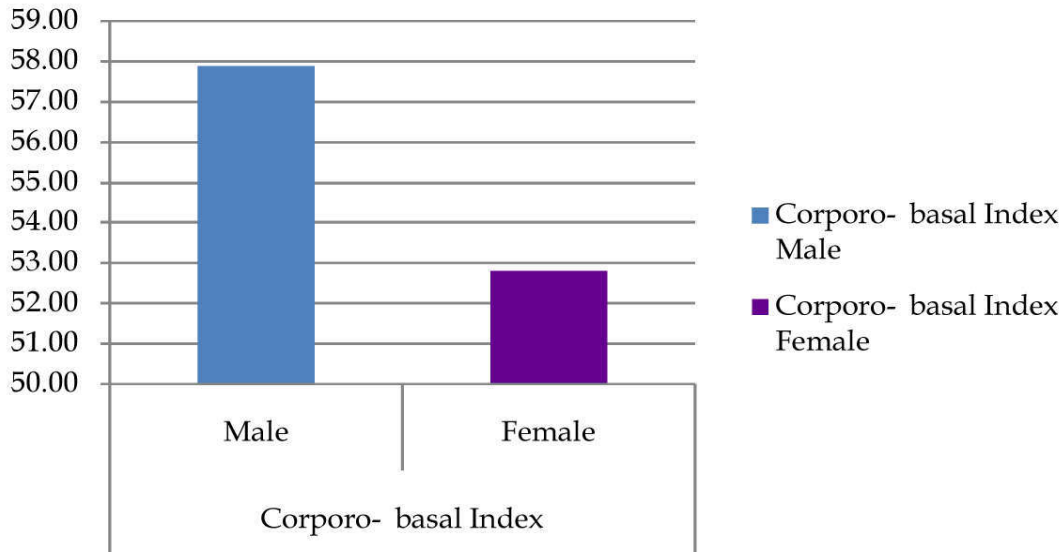
Result

The mean, standard deviation and test of significance were calculated from the data by using SPSS version 19 for the identification of sex using the parameters mentioned above.

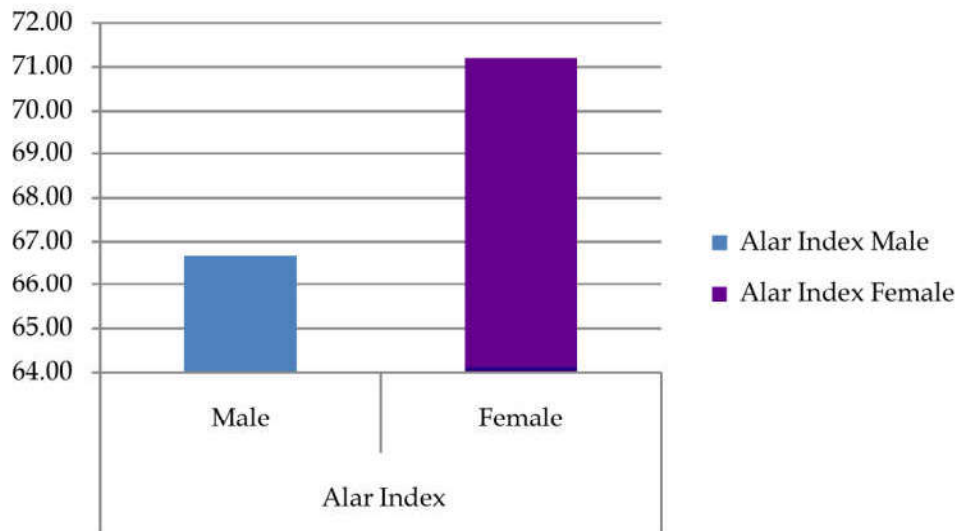
It is observed that mean of sacral maximum width in male is 106.46 and in females it is 98.00 this shows that sacral max width is more in males as compared to female. Sacral minimum width in male is 61.49 and in females it is 57.94 this shows that sacral minimum width is more in males as compared to female though not significant statistically.

Parameter	Sex	Mean ± SD	ANOVA(f)	p value
Sacral Maximum width (mm)	Male	106.46 ± 6.08	22.918	0.000***
	Female	98.00 ± 10.72		
Sacral minimum width (mm)	Male	61.49 ± 8.49	3.446	0.66 (NS)
	Female	57.94 ± 9.98		
Transverse Diameter of Body of First Sacral Vertebra (mm)	Male	48.57 ± 5.61	29.362	0.000***
	Female	41.20 ± 7.53		
Antero-Posterior Diameter of Body of First Sacral Vertebra (S1) (mm)	Male	30.13 ± 3.27	49.824	0.000***
	Female	22.69 ± 7.07		
Length of alae (mm)	Male	32.09 ± 5.01	4.782	0.0035***
	Female	28.9 ± 8.09		
Index of Body of First Sacral Vertebra (S1) (mm)	Male	62.53 ± 10.40	11.776	0.001***
	Female	54.74 ± 14.32		
Corporo-basal Index (mm)	Male	57.89 ± 5.90	15.079	0.000***
	Female	52.80 ± 7.10		
Alar Index (mm)	Male	66.68 ± 10.84	2.715	0.103 (NS)
	Female	71.21 ± 21.20		

*** - statistically highly significant
NS- not significant



Graph 1: Corporo- basal Index



Graph 2: Alar Index

It is observed that mean of Transverse Diameter of Body of First Sacral Vertebra in male is 48.57 and in females it is 41.20 this shows that Transverse Diameter of Body of First Sacral Vertebra is significantly more in males as compared to female.

It is observed that mean Antero-Posterior Diameter of Body of First Sacral Vertebra (S1) in male is 30.13 and in females it is 22.69 the difference being statistically significant .

The mean of Length of alae in male is 32.09 and in females it is 28.90. Length of alae shows more significant difference in males as compared to female.

Discussion

The determination of sex is considered as one of the important steps in the identification of disintegrated remains. It becomes more challenging job for anatomist, when only a single bone like sacrum from entire skeleton is available for giving his opinion. In present study most of the parameters show significant sexual dimorphism.

Index of body of 1st sacral vertebra is significantly higher in males as compared to females in our study. When compared with other studies mean Index of body of first sacral vertebra in male is higher than the

studies by S.S. Dapate [5], Kothapalli et. al [6]. and Mazumdar et. al [7], and it is lower than study done by Shailja Math [8]. The result in present study was almost equal with studies by Rajuet. al. and with Bagde. Mean Index of body of first sacral vertebra in female was found to be lower than the studies by Raju et. al. [9], Bagde, S.S [10] Dapate [5], Shailja Math [8], kothapalli [6] and Mazumdar et. al. [7].

In present study mean Corpora-basal index was found to be significantly higher in male as compared to female sacra. Similar results were found in studies done by in Mishra et. al [11], Kanika et. al. [12], Mazumdar et. al. [7], Kothapalli [6] and Shreekrishna HK [13].

Alar index do not show significant variation in male and female sacra in our study. It was the only index which was more in female as compared to male sacra. Study by Kothapalli [6] show results comparable with our study. Study by Mishra et. al. [11] show significant variation in Alar index between male and female sacra.

Sacral parameters like Index of body of first sacral vertebra and Corporo-basal Index in our study are more significant parameters than alar index for sexual dimorphism in sacra.

Conclusion

The present study has very significant role to determine appropriate indices of sexual dimorphism for sacral bone. The study concludes that no single index can identify sex of sacrum accurately so we suggest use of multiple indices for sex determination of sacral bone over any single index.

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