



SEXUAL DIMORPHISM IN SACRUM

Anatomy

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ABSTRACT

Introduction: Determination of sex from the skeletal remains is of tremendous medico-legal importance for establishing the identity of an individual. Sacrum has always attracted the attention of medico-legal experts for establishing sex. **Aims and Objectives:** To study the sexual differences in an adult human sacrum and thus identify a male from a female sacrum using various parameters. Then comparing my observations with that of other works to conclude. **Materials and Methods:** 254 dried, completely ossified, grossly normal human adult sacrum of both sex were taken from medical colleges in Udaipur and Jaipur. Currently the method used for sexing the adult sacrum are either univariate, multivariate or the combination of both, all of which involve the use of metric measurements also the statistical tests are now routinely carried out to test the validity and reliability of the involved parameters. Present study is made to assess the sex of unknown sacra, with various sacral indices and measurements. The results of these are compared with the studies of other workers. Hoping that this attempt of work will serve as a guideline in assessing the sex of sacrum from this region **Summary and Conclusion:** After a detailed study and comparison of my work with other workers, I conclude that identification point and demarking point help in sexing the sacrum with certainty. The most useful index for sex determination of sacrum in the present study is sacral index.

KEYWORDS

INTRODUCTION:

Sexual dimorphic characters can be studied both morphologically and metrically. Morphometric studies pose several problems such as difficulties with quantification and interobserver bias. Geometric Morphometrics is relatively a more reliable method. Sacrum is one of the bones that exhibit sex differences, because of its contribution to pelvic girdle and associated functional sex differences. Hence, it is used in the identification of skeletal remains. Authors have studied sexual dimorphism wherein sacra of known sex were selected and the validity of the parameters was verified. Though sacrum is often considered to be an important bone while dealing with sex differences in skeletal material, yet there is a paucity of metrical data available for this bone. This study is undertaken so as to study sexual dimorphism in sacrum.

AIMS AND OBJECTIVES

The present work is planned to study the differences between a male and female sacrum based on the measurements of an adult human sacra from Udaipur and Jaipur district.

Objectives of the Study: Present study is aimed towards the following objectives:

1. To study the sexual differences in an adult human sacrum and thus identify a male from a female sacrum.
2. To study the accuracy and limitations of various sacral indices and measurements in identifying the sex of an adult human sacrum.

Review Of Literature

Several researchers have noted the sex wise variations in the number of sacral vertebrae, some workers also have established certain parameters for different populations and have described the variations in the vertebral column as a whole (Trotter¹, 1926). Moreover, according to Todd and Tracey²(1930) such non-metric methods were useful more in establishing the racial differences than the sex dimorphism. Fisher³(1936) was the first person to bring forward the multivariate statistical analysis. Afterwards this method was extensively used by Bronowski and Long⁴ (1951) for classification of teeth, later Thieme⁵ (1957) for sexing long bones.

According to JE Frazer⁶ (1965), the sacrum presents sexual distinctions. The female bone is broader than the male in proportion to its length, and shows a different anterior curve: in the male the curve is more or less uniform from above downward, but in the female it is sharply marked at the lower part of the bone, the upper portion being almost flat.

The difference in breadth between the bones is well expressed by the "sacral index," in which the breadth (at the base) is multiplied by 100 and divided by the anterior length;

Charnalia⁷ in 1967 studied 60 male and 30 female sacra from South India and calculated the sacral index, index of body S1, the carporobasal index and curvature index of the sacrum. Flander⁸ (1978) used univariate and multivariate methods for sexing the sacrum.

Bagde⁹ in 1981 studied several parameters on the basis of metric measurements of 65 males and 30 females sacra from Marathwada region. The findings indicated that the length of the sacrum was the most suitable parameter followed by anterior-posterior diameter and transverse diameter of the body of S1.

The sacral and carporobasal index were less reliable than the other parameters.

Meindl et al¹⁰ (1985) put forward the hypothesis that the female pelvis is less variable than that of male Singh et al¹¹ 1988 studied 26 male and 11 female sacra from Jammu and Kashmir area and concluded that the sacral index was useful in sexing the adult sacra.

Peter L William et al¹² (2000), the sacrum displays metrical sexual differences in addition to orientation. The sacral index compares sacral breadth with length average values for male + female are 105 and 115% Arora et al, in 2010¹³, by using sacral index carried a study for sexing sacrum using 40 sacra (20 male & 20 female sacra) in Punjab. The results were compared with the available literature. It was found that D.P of sacral index was very reliable in sexing of sacra

The pelvis has been utilized by number of workers for determination of sex. The studies on the sacrum alone as a determinant for sex are very few. As a part of pelvis, it is capable of demonstrating the sexual dimorphism which should be standardized for the purpose of sex identification.

Sex Differentiation

Male Female

MATERIALS AND METHOD

	Male	Female
Measurements	Length is more than breadth	Almost equal
Pelvic surface	Longer narrower often 5+ segments	Shorter broader 5 segments a rule
Pelvic curve	Curve is regular and gradual	Abruptly curved forward
Auricular surface	Approaches more than 2 ½ sacral vertebrae and upto upper half of 3rd sacral vertebrae.	Extends up to 2nd sacral vertebrae and lies less than 2 1/2 sacral vert.
Muscular impressions	Heavily marked	less

Weight	Heavier	Lighter
Size of body and Ala	Transverse measurement of the body of 1st sacral vertebrae is more than ala of any one side	Transverse measurement of body of S1 is roughly equal to that of ala of any one side
Sacral index	Less 105%	More 115 %

Source of Data:

254 sacra of both sexes are used in this work, and are collected from medical colleges of Rajasthan state. All the sacra which are completely ossified and with no deformity were taken. Sacra that are not ossified are excluded.

Instruments used for the present work are: 1. Vernier calipers 2. ribbon tape 3. Scientific balance and weights. 4. Divider.

From each sacrum, following metrical data is recorded.

1. Ventral Straight Length
2. Ventral Curved Length
3. Maximum Transverse width.
4. Minimum transverse width.
5. Transverse diameter of S1.

OBSERVATIONS

Table1. Ventral straight length in Cms.

Detail measurements	male	female
Length cm		
Total no. of bones	190	64
Range	8.2-13.2	7.8-11.1
Mean	11.1	9.45
Std.Deviation	.84	.85
Statistical significance	Highly	Highly
Identification point	>11.5	<9.2
Calculated point	8.84-13.66	7.61-12.43
Demarking point	>12.43	<8.84
%beyond dp	7.35%	7.21%
%of identified bone	29.12	29.81
Statistically highly significant p<0.001		

2. Ventral curved length cms.

Detail measurements cm	male	female
Total no. of bones.	190	64
Range	9.2-14.1	8.5-11.5
Mean	11.26	10.02
Std Deviation	0.805	0.803
Statistical significance	HS	HS
Identification point	>11.5	<9.2
Calculated range	8.84-13.66	7.63-12.43
Demarking Point	>12.43	<8.84
%beyond dp	7.35	7.21
% of identified bone	29.12	29.81
Statistically Highly significant p<0.001		

3. Max Transverse length(width)cms.

Detail measurements width cm.	Male	Female
Total no. of bones	190	64
Range	6.5-14.2	9.2-12.1
Mean	10.42	10.63
Std. deviation.	0.90	0.691
Statistical Significance.	ns	ns
Identification point	>12.1	<6.5
Calculated range	7.72-13.17	8.56-12.70
Demarking point	>12.70	<7.72
%beyond dp	0.57%	0%
%of identified bone	3.07	0%
Statistically not significant >0.05		

Table4. Mini Transverse Length width cms

Detailed measurements	Male	Female
Total no. of bone.	190	64
Range	2-4.8	
Mean	3.09	2.31
Std.Deviation.	0.58	0.30

Statistical significance	H.S.	H.S.
Identification point	>3.0	<2.0
Calculated range	1.35-4.83	1.41-3.21
Demarking point	>3.21	<1.35
%beyond dp	42.46%	0%
%of identified bones	43.64%	15.15%
Statistically significant p<0.001		

Table5. Transverse Diameter of body of S1 in cms

Detailed measurements	Male	Female
Total no. of bone.	190	64
Range	2.5-6.7	2.1-5.9
Mean	4.89	3.90
Std.Deviation.	0.82	0.89
Statistical significance	H.S.	H.S.
Identification point	>5.9	<2.5
Calculated range	2.43-7.35	1.23-6.57
Demarking point	>6.57	<2.43
%beyond dp	2.12%	4.95%
%of identified bones	10.93%	10.93%
Statistically significant p<0.001		

Table6. Anterior Posterior diameter of body of S1 cm

Detailed measurements	Male	Female
Total no. of bone.	190	64
Range	2.0-3.9	2.0-4.0
Mean	2.85	2.72
Std.Deviation.	0.37	0.36
Statistical significance	Signi	Signi
Identification point	>4.0	<2.0
Calculated range	1.74-3.96	1.64-3.8
Demarking point	>3.8	<1.74
%beyond dp	0.14%	0.33%
%of identified bones	0.1%	2.28%
Statistically significant p<0.05		

Table7. Weight in grams

Detailed measurements	Male	Female
Total no. of bone	190	64
Range	35.0-96.0	20.0-75
Mean	62.65	39.84
Std.Deviation	14.71	12.07
Statistical significance	H.S.	H.S.
Identification point	>75	<35
Calculated range	18.55-106.75	3.63-76.05
Demarking point	>76.05	<18.55
%beyond dp	18.14%	<18.55
%of identified bones	20.03%	34.44%
Statistically significant p<0.001		

Table 8. Sacral index

Detailed measurements	Male	Female
Total no. of bone	190	64
Range	53.57-152	91.89-146.15
Mean	94.24	113.19
Std.Deviation	11.78	10.26
Statistical significance	H.S.	H.S.
Identification point	>146.15	<63.57
Calculated range	58.9-12.9.58	82.41-143.97
Demarking point	>143.97	<58.9
%beyond dp	0	0
%of identified bones	0	0
Statistically significant p<0.001		

Table 9. Index of S1

Detailed measurements	Male	Female
Total no. of bone	190	64
Range	35.94-100.00	46.0-120.83
Mean	59.79	72.4
Std.Deviation	13.55	18.72
Statistical significance	H.S.	H.S.
Identification point	>120.83	<35.94

Calculated range	29.14-100.44	16.24-128.56
Demarking point	>128.56	<29.4
%beyond dp	0	11%

SUMMARY AND CONCLUSIONS

After a detailed study and comparison of the present study with other studies, it can be concluded that: Identification point and Demarking Point help in sexing the sacrum with certainty. In order of reliability ventral curved length, ventral straight length, maximum width at S₁, weight in grams and transverse diameter and AP of body of S1 vertebra help in sexing of the unknown samples of sacrum.

The most useful index for sex determination of sacrum in present study is sacral index.

Key words:

Sacral index. The difference in breadth between the bones is well expressed by the "sacral index," in which the breadth (at the base) is multiplied by 100 and divided by the anterior length;

RESULTS:

In my study, the male sacrum shows significantly higher values for ventral straight length, ventral curved length, transverse diameter of S₁ and anteroposterior of S₁ and weight, than the female sacrum, while the female sacral index showed higher values when compared with that of male.

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