



SEXUAL DIMORPHISM IN SACRUM- A MORPHOMETRIC STUDY OF NASIK POPULATION

KEYWORDS

Sacrum, Sacral index, Curvature index, Nasik Population

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ABSTRACT *Introduction:* Sacrum is an important bone while dealing with sex difference in human skeletal system. Sexual dimorphic characters of sacrum can be studied both morphologically and metrically. *Material and Methods:* 132 dry human sacra from the department of anatomy and department of Forensic Medicine And Toxicology, SMBT institute of Medical Sciences & Research centre, Nasik, Maharashtra were included in the study. The sliding vernier calliper was used to take maximum length and maximum breadth of sacrum. Standardized flexible steel tape for Curved length of sacrum. **Result :** It was found that the demarking point of sacral index is most reliable in the sexing of sacra. **Conclusion:** We concluded that sacral index is the most important parameter as far as the sex determination of sacrum.

INTRODUCTION:-

Sacrum is a wedge shaped triangular bone. The word sacrum is derived from Latin word 'sacred'. It is considered to be 'sacred bone' because it occupies the lowest part of back which is invariably covered as mark of respect. The base of wedge is superior and forms the base of sacrum. Edge of the wedge form the inferior apex. It has four surfaces and one sacral canal is present¹.

Anatomical science has its roots in medical sciences especially anthropology. Sacrum is an important bone while dealing with sex difference in human skeletal system². Sexual dimorphic characters of sacrum can be studied both morphologically and metrically. Among various bones sacrum has always attracted the attention of medico-legal experts for establishing sex, possibly because of its contribution to pelvic girdle and associated functional sex differences³.

The well known method for determination of male or female type of sacrum has always been the "Sacral Index". The Sacral Index is calculated by the following formula: Sacral Index = Width of Sacrum x 100 / Height of Sacrum⁴.

Different authors had carried various types of measurements on human sacra of different races and regions. Raju et al⁵ (1980) observed that only sacral length and transverse diameter of body of S1 have some reliability in sexing the male sacrum. Singh and Singh⁶ (1972) have shown that demarking point should be calculated separately for different regions of population because the mean of a parameter differs in values in different regions. Comas and Charles⁷ stated that wide variations exist between male and female sacrum in Chinese and Negroes.

In this study we have chosen the bone sacrum for sex determination of Nasik population. Observations were tabulated and compared with the results of previous workers.

MATERIAL AND METHODS:

After obtaining permission from institutes we examined 132 dry human sacra from the department of anatomy and department of Forensic Medicine And Toxicology, SMBT

institute of Medical Sciences & Research centre, Nasik. Each sacrum was studied for different features of sexual dimorphism. The sliding vernier calliper was used to take maximum length and maximum breadth of sacrum. Standardized flexible steel tape. The following parameters were considered.

Maximum breadth of sacrum : The stem of caliper was applied to upper surface of the body of first sacral vertebra and measurement of maximum breadth was taken across the greatest expanse of lateral masses of the bone.

Maximum length of sacrum : The maximum height or length was measured by applying the sliding caliper to middle of promontory and middle of anteroinferior border of fifth sacral vertebra.

Curved length of sacrum : It is measured along with the midline of the anterior surface of the sacrum (from middle of anterosuperior margin of promontory to middle of anteroinferior margin of the last sacral vertebra) by the flexible steel tape.

The following formulas are used for calculation of Sacral Index and Curvature index:

Sacral index :

$$\frac{\text{Sacral breadth}}{\text{Sacral length}} \times 100$$

It is sacral width as a percentage of length. That is maximum width of the sacrum when the maximum length of the sacrum is 100.

Curvature Index = .

$$\frac{\text{Straight length}}{\text{Mid-ventral curved length}} \times 100.$$

It is the maximum mid-ventral straight length when the maximum mid-ventral curved length of sacrum is 100.

For identification of Male sacrum, the demarking point

(D.P.) of a particular measurement was more than 3 S.D. of mean value for female, and, for identification of Female sacrum, the D.P. of same measurement was less than 3 S.D. of mean value for male. The result obtained was analyzed and discussed.

RESULTS:

The study was conducted in SMBT institute of Medical Sciences & Research centre in Nasik. Total 132 sacra were enrolled in this study.

TABLE 1:- Showing Maximum breadth of sacrum in mm

Parameters	Sex	Range	Mean	SD	t value	p value	Calculated range Mean + 3 S.D.	D. P.	% of bone identified by D. P.
Maximum Breadth	Male	90-118	104.2	6.98	0.401	>0.05	83 to 122	<84.98	0
	Female	92-116	105.34	6.32			86.83 to 124	>124	0

Above table showing that the maximum breadth of the sacrum in males ranged from 90-118 mm, in females it ranged from 92-116 mm. Demarking Points (D.P.) of sacral breadth and the percentage of bones in which sex could be identified by them, are given in Table 1.

TABLE 2:- Showing Maximum length of sacrum in mm

Parameters	Sex	Range	Mean	SD	t value	p value	Calculated range Mean + 3 S.D.	D. P.	% of bone identified by D. P.
Maximum Length	Male	90-122	108.93	7.45	15.40	<0.001	87.33 to 124.62	>104.48	68.6
	Female	85-102	94.05	5.04			80.88 to 123	<88.42	27.3

Above table showing that the maximum length of the sacrum in males ranged from 90-122 mm, in females it ranged from 85-102 mm. Demarking Points (D.P.) of sacral length and the percentage of bones in which sex could be identified by them, are given in Table 2.

TABLE 3:- Showing sacral index and their statistical analysis

Parameters	Sex	Range	Mean	SD	t value	p value	Calculated range Mean + 3 S.D.	D. P.	% of bone identified by D. P.
Sacral index	Male	92.3-104	97.52	4.8	9.2	<0.001	83.54 to 108.3	<97.01	60.25
	Female	101.9 -128	112.52	5.4			94.03-128	>110.2	67.85

Above table showing that the sacral index range for male was 92.3 to 104 and in females it was 101.9 to 128; Mean for males was 97.52 and for female 112.52, as show in table 3. The demarking point for male was <97.01 and female >110.2. Therefore the percentage for demarking point for males 60.25% and for female was 67.85%.

TABLE 4:- Showing Curved length and Curvature Index of sacrum their statistical analysis

Parameters	Sex	Range	Mean	SD	t value	p value	Calculated range Mean + 3 S.D.	D. P.	% of bone identified by D. P.
Curved length	Male	94-130	117.65	7.91	7.09	<0.001	88.37-136	>121.81	11.9
	Female	91-118	102.32	6.26			80-120	<86.02	0
Curvature Index	Male	90.01-96.3	93.3	1.76	9.23	<0.001	87.52-100.32	>102.32	0
	Female	84.12-99.98	88.6	3.01			79.32-99	<82.27	17.5

Above table showing that the curved length of the sacrum in males ranged from 94-130mm, in female it was 91-118 mm. Curvature index of sacrum in males ranged from 90.01-96.3mm, in female it was 84.12-99.98mm. Demarking Points (D.P.) of curved length and Curvature index and the percentage of bones in which sex could be identified by them, are given in Table 4.

DISCUSSION:

In the present study sex determination of these sacral bones was done using different measurement and indices. Result of our study indicates that sacral index is suitable for sex determination. The mean length of male sacra of Nasik region (108.93 mm) is higher than that of Agra region (107.53mm) studied by Mishra S.R² (2003). However the female sacra of Nasik region are higher than the Agra region. A regional and racial difference in the length of sacrum therefore exists.

Flander's study was useful because she had developed a technique to assess sex and race simultaneously by using sacra from American Blacks and Whites (50 each sex-race)⁸. M.M Patel⁹ (2005) had adopted two methods for sexing of sacrum; one was the sacral index method as described by Hrdlicka's Practical Anthropometry and other method was of Kimura's Base-Wing index method. Out of these two method sacral index method; 62.5% of male sacra were identified (demarking point) and 68.75% of female sacra

(demarcating point) were identified. In our present study the mean sacral index of male sacra 97.52 falls under dolicho-heric group (narrow sacrum with sacral index up to 99.9) and in female sacra 112.52. Nisha yadav obtained mean value of sacral index to be 98.44 in males and 113.73 in female¹⁰.

Our results shows that mean breadth of male sacra 104.2 and in female it was 105.34 in Nasik region similar to observation made by Raju et al⁵ (1980) in the Varanasi region. Bindra et al¹¹ (2015) studied in Haryana region that maximum breadth of male sacra 108.24 and in female 106.87. The range of curved length of male sacra is higher than that of female in Nasik population. Present findings matched nearly with the findings of Vasantha Maddikunta¹² (2014) and Mishra² (2003).

Mean value of Curvature index of sacrum in males 93.3, in female it was 88.6. Vasantha Maddikunta¹² result shows mean value for curvature index of sacrum in males is 90.8% and in females 90.1%. Similar result found in Agra region by Mishra². Comparison of our study with Shreekrishna HK et al³ curvature index mean value in male and female somewhat equal.

CONCLUSION :

The present study shows that demarcating point help in sexing the sacrum with high accuracy. For identify the sex of sacrum all parameter are consideration to greater accuracy. We concluded that sacral index is the most important parameter as far as the sex determination of sacrum.

REFERENCES:

1. Nafis Ahmad Faruqi, "Human Osteology" a clinical orientation. 2nd edition: CBS publishers & Distributors :2012. p. 206-214.
2. Mishra, S.R.; Singh, P.J.; Agrawal, A.K., Gupta, R.N. Identification Of Sex Of Sacrum Of Agra Region. *J Anat. Soc. India* 52(2) 132-136 (2003).
3. Shreekrishna HK, Yatiraj S, Vijayakumari N. Credibility of Various Indices of Sacrum in Identification of Sex of Sacrum. *International Journal of Medical Toxicology and Forensic Medicine*. 2013;3(2): 58-63.
4. Stewart TD. Hrdlicka's Practical Anthropometry: 4th edition. The Wistar Institute of Anatomy & Biology, Philadelphia. 1952 : p. 172.
5. Raju PB, Singh S, Padmanabhan R. Sex determination and sacrum. *Journal of Anatomical Society of India*.1980; 30:13-15.
6. Singh, S.P. and Singh, S. (1972) : Identification of sex from the humerus. *Indian Journal of Medical Research*. **60** 1061-1066.
7. Comas J, Charles C. *Manual of Physical Anthropology*. Illinois, USA: Thomas Springfield; 1961: p.415-16.
8. Flander LB. Univariate and multivariate methods for sexing the sacrum. *American journal of physical Anthropology*. 1978 ; 49 (1) : 103 - 110.
9. M.M. Patel, B.D. Gupta, T.C. Singh. Sexing Of Sacrum By Sacral Index And Kimura's Base-Wing Index. *JIAFM*, 2005 : 27 (1). ISSN 0971-0973.
10. Nisha Yadav, Kopal Saini, Kalpana Patil. Determination Of Sex Using Dry Adult Human Sacrum- A Morphometric Study. *Int J Cur Res Rev | Vol 7 • Issue 3 • February 2015*.
11. Bindra GS, Mohan A. Sacral Index: Application in sex determination of sacrum. *Int J Sci Stud* 2015;2(10):79-81.
12. Vasantha Maddikunta*, M. Ravinder. Morphometric study of sacrum in sex determination in Telengana region people. *Int J Res Med Sci*. 2014 Feb;2(1):164-174.