

Research Article

Morphometric study of sacrum in sex determination in Telengana region people

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ABSTRACT

Assessment of sex of the bone comes under the Canopy of Forensic Anthropology, which has its main roots in anatomy. Hence sound knowledge of anatomy particularly morphometric data is essential for identification of sex, race and region. Bones of pelvic girdle play key role for determination of sex. In addition to hip bones, sacrum also has its own importance in determination of sex. Hence in this study we have taken various parameters (maximum length of sacrum, maximum breadth of sacrum, Curved length of sacrum, transverse diameter of S1) and different indices (sacral index, curvature index, corporobasal index). From the above parameters and indices we have extracted demarcating points for each, which have statistical significant role in determining the male and female sex, which were discussed in detail in this publication.

Keywords: Curved length of sacrum, Transverse diameter of S1, Sacral index, Curvature index, Corporobasal index

INTRODUCTION

Assessment of sex of the bone comes under the Canopy of Forensic Anthropology. Forensic Anthropology has its roots in medical sciences especially Anatomical Sciences. Hence sound knowledge of Anatomy of the bones (particularly morphometrical data) is essential for identification of sex, race and region. In this study I have chosen the bone sacrum for sex determination for its strength and contribution to pelvic girdle and associated sexual differences. Metric study of sacrum has been done by various authors in foreign countries.

Edward Fawcett¹ in the year 1931 studied the Sexing of Human Sacrum. Sexing value of the corporobasal index is good. It consists of comparing the transverse diameters of the first sacral vertebra with the transverse diameter of the base of the sacrum.

Jana² in the year 1978 studied variations in sacral hiatus and significance of sacral and hiatal indices in sexing of sacrum.

Louisa Beyer Flander³ in the year 1978 studied univariate and multivariate methods for sexing the sacrum. Showing corporobasal index is more useful in sexing the bones than other measurements.

Raju⁴ in the year 1980 carried out metric analysis of 33 male and 11 female sacra from Varanasi region. They observed that only sacral length and transverse diameter of body of S1 have some reliability in sexing the male sacrum.

Bagde⁵ in the year 1981, the findings indicated that the length of the sacrum was the most suitable parameter followed by anteroposterior diameter and transverse

diameter of the body of S1. The sacral and corporobasal indices were less reliable than the other parameters.

Vinod Kumar et al.⁶ in the year 1984 studied 90 adult human sacra from Jhansi. The sacral index was observed to be a more useful parameter in determining the sex.

Singh⁷ in the year 1988 concluded that the sacral index was useful in sexing the adult sacra.

The available literature clearly shows that the morphometric study of sacrum for the determination of sex in Indian bones has not been done widely except by Singh and Raju (1980) and Jana et al. (1978).

In the present study, 60 sacra were observed. The sex determination of these bones was done using different parameters and indices. Observations were tabulated and compared with the results of previous workers.

METHODS

The material for the present study consisted of 60 adult sacra (27 male and 33 female). These sacra were selected after rejecting the bones having any fractures, pathology or wear and tear.

Instruments used for the present work are:

1. Stainless steel sliding vernier callipers.
2. Standardized flexible steel tape.

With stainless steel sliding vernier callipers, each linear measurement was taken in centimeters up to two decimals and recorded in millimeters.

Procedure for measuring the following parameters of each sacrum:

1. **Maximum Length of Sacrum:** This parameter also called (Midventral Straight Length) measured along the midline of sacrum with the sliding calipers from the middle of the antero-superior margin of promontory to the middle of anteroinferior margin of the last sacral vertebra.
2. **The Maximum Breadth of the Sacrum:** Measured with the sliding calipers by taking two points at the upper part of the auricular surface anteriorly (or lateral most part of Alae of Sacrum). Thus breadth is measured on anterior aspect of sacrum.
3. **Curved Length of Sacrum:** (Mid-Ventral Curved Length) is measured by the flexible steel tape.
4. **Transverse diameter of the body of the 1st sacral vertebra:** It is the maximum transverse diameter of 1st sacral vertebra measured with the sliding calipers by taking one point on each side of the lateral most point on the superior surface of body of 1st sacral vertebra

By using the above measurements the following indices were calculated

1. Sacral Index:

$$\text{Sacral Index} = \frac{\text{Sacral breadth}}{\text{Mid - ventral straight length of the sacrum}} \times 100$$

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.

2. Curvature Index:

$$\text{Curvature Index} = \frac{\text{Mid - ventral straight length of the sacrum}}{\text{Mid - ventral curved length}} \times 100$$

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

3. Corporo-basal Index:

$$\text{Corporo-basal Index} = \frac{\text{Transverse diameter of body of S1}}{\text{Maximum breadth of sacrum}} \times 100$$

It is the transverse diameter of body of S1 when the breadth of the sacrum is 100.

From the obtained values, demarking points were calculated on the lines of Jit and Singh 1966 and the percentage of the bones, thus identified were found out in relation to each parameter.

The mean of the ventral straight length of sacrum in male is 113.9 mm (11.39 cm) to this value 3 times the standard deviation is added and subtracted and this gives the calculated range (3 x S.D. ± mean = C.R.)

Thus for ventral straight length for sacrum in males the calculated range comes to 79.31 mm to 148.49 mm. Similar calculations are made for the ventral straight length of the sacrum in females and the calculated range comes to 62.61 mm to 117.39 mm. Thus the demarking points for ventral straight length of sacrum for males comes to >117.39 mm and females comes to <79.31 mm. This would cover 99.75% of the sample and due to which much accuracy can be obtained in sexing of an unknown specimen of sacrum.

Similarly all the parameters were subjected to arrive at the demarking points, and percentage of identified bones were recorded in the observation tables.

Identification point is a limiting point of actual range of every measurable parameter in male and female.

RESULTS

In the present study, 60 adult sacra (27 male & 33 female) were studied. From each sacrum, various metrical parameters were measured and indices deduced.

By using the formulae, the following details were obtained from the above metrical data. They were the range, mean, standard deviation, 't' value, 'p' value, Calculated range, Demarking point and Percentage of Bones in which sex could be identified*.(Each single metrical parameter was tabulated in individual tables and charts which were shown in tables numbered from 1 to 7 and charts numbered from 1 to 7.)

Mid Ventral straight length in mm

Table 1 shows that the mid ventral straight length of the sacrum in males ranged from 90-140 mm, in females it ranged from 70-110 mm. There is an overlapping in the mid ventral straight length of the male and female bones between 90 & 110 mm range.

From the calculated ranges the demarking points for male and female are derived.

Table 1: Mid ventral straight length in mm.

Detailed measurements (mm)	Male (N)	Female (N)
70 – 80	-	4
80 – 90	-	12
90 – 100	2	11
100 – 110	11	6
110 – 120	4	-
120 – 130	7	-
130 – 140	3	-
Total	27	33
Range	93.60 – 131.00 (mm)	78.14 – 106.80 (mm)
Mean	113.9 (mm)	90.0 (mm)
Std. deviation	11.53	9.13
Statistical significance 't' value	8.78	8.78
Statistical significance 'p' value	<0.01	<0.01
Calculated bone range (CR)	79.31 to 148.49	62.61 to 117.39
Demarking point	>117.39	<79.31
% of identified bone	74.1%	48.5%

t = 8.78
 p = <0.01
 Statistically significant

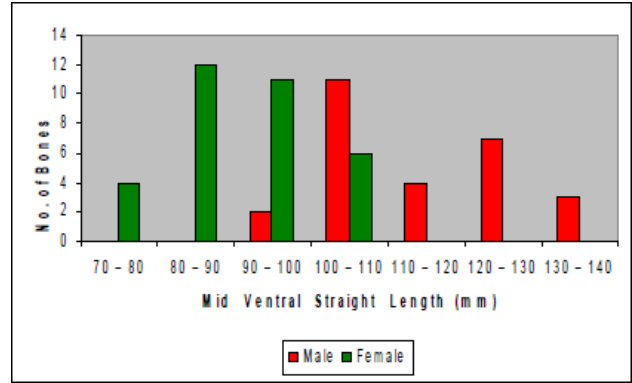


Figure 1: Mid ventral straight length in mm.

Maximum breadth of sacrum in mm

Table 2 shows that the maximum width of the sacrum in males ranged from 90-120 mm, in females it ranged from 90-120 mm. There is an overlapping in the maximum width of sacrum of the male and female bones between 90 & 120 mm range.

Table 2: Maximum breadth of sacrum in mm.

Detailed measurements (mm)	Male (N)	Female (N)
70 – 80	0	0
80 – 90	0	0
90 – 100	8	10
100 – 110	12	17
110 – 120	7	6
120 – 130	0	0
130 – 140	0	0
Total	27	33
Range	92.30 – 115.30 (mm)	94.40 – 103.40 (mm)
Mean	104.2 (mm)	103.4 (mm)
Std. deviation	6.98	6.02
Statistical significance 't' value	0.441	0.441
Statistical significance 'p' value	>0.05 NS	>0.05 NS
Calculated bone range (CR)	83.26 to 125.14	85.34 to 121.46
Demarking point	<85.34	>125.14
% of identified bone	0%	0%

t = 0.441
 p = >0.05 NS
 Not significant

From the calculated ranges the demarking points for male and female are derived.

Mid Ventral curved length in mm

Table 3 shows that the mid ventral curved length of the sacrum in males ranged from 90-120 mm, in females it ranged from 90-120 mm. There is an overlapping in the mid ventral curved length of the male and female bones between 90 & 120 mm range.

From the calculated ranges the demarking points for male and female are derived.

Table 3: Mid ventral curved length in mm.

Detailed measurements (mm)	Male (N)	Female (N)
70 – 80	-	-
80 – 90	-	-
90 – 100	8	10
100 – 110	12	17
110 – 120	7	6
120 – 130	-	-
130 – 140	-	-
Total	27	33
Range	103.00– 141.00 (mm)	87.00 – 118.00 (mm)
Mean	125.0 (mm)	100.0 (mm)
Std. deviation	12.46	9.07
Statistical significance 't' value	8.720	8.720
Statistical significance 'p' value	P<0.01	P<0.01
Calculated bone range (CR)	87.62 to 162.38	72.79 to 127.38
Demarking point	>127.38	<87.62
% of identified bone	63%	0%

t = 8.720
p = <0.01
Statistically significant

Transverse diameter of body of S1 in mm

Table 4 shows that the Transverse Diameter of body of S₁ of the sacrum in males ranged from 35-60 mm, in females it ranged from 35-60 mm. There is an overlapping in the Transverse Diameter of body of S₁ of

sacrum of the male and female bones between 35 & 60 mm range.

From the calculated ranges the demarking points for male and female are derived.

Table 4: Transverse diameter of body of S₁ in mm.

Detailed measurements (mm)	Male (N)	Female (N)
25 – 30	0	0
30 – 35	0	0
35 – 40	3	7
40 – 45	6	9
45 – 50	5	12
50 – 55	7	2
55 – 60	6	3
Total	27	33
Range	38.20 – 58.40 (mm)	36.70 – 57.50 (mm)
Mean	48.7 (mm)	44.9 (mm)
Std. deviation	6.41	5.72
Statistical significance 't' value	2.42	2.42
Statistical significance 'p' value	P<0.05	P<0.05
Calculated bone range (CR)	29.47 to 67.93	27.74 to 62.06
Demarking point	>62.06	<29.47
% of identified bone	63%	18.2%

t = 2.42
p = p<0.05
Statistically significant

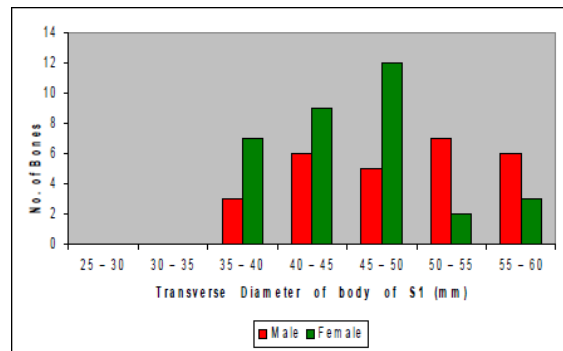


Figure 2: Transverse diameter of body of S₁ in mm.

Sacral index

Table 5 shows that the Sacral Index in males ranged from 80-100 mm, in females it ranged from 100-140 mm. There is an overlapping in the Sacral Index of the male and female bones between 80 & 140 mm range.

From the calculated ranges the demarking points for male and female sacra are derived.

Table 5: Sacral index.

Detailed measurements	Male (N)	Female (N)
Distribution of sacral index (%)		
70 – 80	0	0
80 – 90	10	0
90 – 100	17	0
100 – 110	0	11
110 – 120	0	11
120 – 130	0	8
130 – 140	0	3
Total	27	33
Range (%)	83.10 – 97.38	101.77– 132.15
Mean (%)	91.8	116.3
Std. deviation	4.99	9.51
Statistical significance ‘t’ value	-12.8	-12.8
Statistical significance ‘p’ value	P<0.01	P<0.01
Calculated bone range (CR)	76.83 to 106.77	87.77 to 144.83
Demarking point	<87.77	>106.77
% of identified bone	3.7%	9.1%

t = -12.8
 p = P<0.01
 Statistically significant

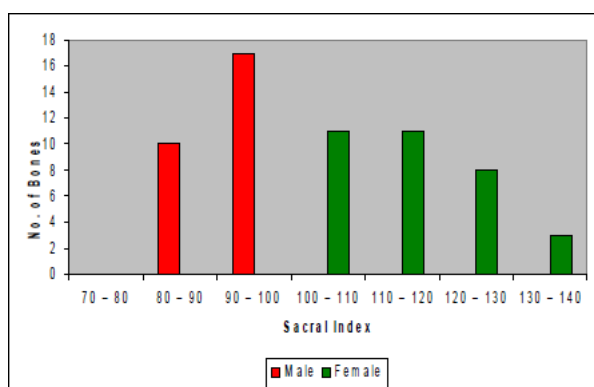


Figure 3: Sacral index.

Curvature index of sacrum

Table 6 shows that the Curvature Index of sacrum in males ranged from 80-105 mm, in females it ranged from 80-100 mm. There is an overlapping in the Curvature Index of sacrum of the male and female bones between 80 & 100 mm range.

From the calculated ranges the demarking points for male and female sacra are derived.

Table 6: Curvature index of sacrum.

Detailed measurements	Male (N)	Female (N)
Distribution of curvature index of sacrum (%)		
80 – 85	6	3
85 – 90	7	14
90 – 95	8	11
95 – 100	5	5
100 – 105	1	0
105 – 110	0	0
110 – 115	0	0
Total	27	33
Range (%)	81.8 – 104.27	82.5 – 98.88
Mean (%)	90.8	90.1
Std. deviation	5.59	4.24
Statistical significance ‘t’ value	0.6	0.6
Statistical significance ‘p’ value	>0.05 NS	>0.05 NS
Calculated bone range (CR)	74.03 to 107.57	77.38 to 202.82
Demarking point	>102.82	<74.03
% of identified bone	96.3%	9.1%

t = 0.6
 p = >0.05
 Statistically not significant

Corporobasal index

Table 7 shows that the Corporobasal Index in males ranged from 35-55 mm, in females it ranged from 25-55 mm. There is an overlapping in the Corporobasal Index of the male and female bones between 35 & 55 mm range.

From the calculated ranges the demarking points for male and female sacra are derived.

DISCUSSION

In the present study, 60 sacra were observed. The sex determination of these bones was done using different measurements and indices.

To be certain in identification, calculated range has to be considered, which is derived by adding and subtracting 3 times the standard deviation to and from the mean of any parameter (mean of any parameter ± 3 x SD). The

limiting point of such calculated range is called a 'demarking point', which identifies sex from any given region (Raju et al. 1980).

Table 7: Corporobasal index.

Detailed measurements	Male (N)	Female (N)
Distribution of corporobasal index (%)		
25 – 30	0	1
30 – 35	0	0
35 – 40	2	6
40 – 45	7	16
45 – 50	11	7
50 – 55	7	3
55 – 60	0	0
Total	27	33
Range (%)	39.0 – 53.77	27.43 – 32.67
Mean (%)	46.6	42.9
Std. deviation	4.86	4.97
Statistical significance 't' value	3.0	3.0
Statistical significance 'p' value	P<0.01	P<0.01
Calculated bone range (CR)	32.02 to 61.18	27.99 to 57.81
Demarking point	>57.81	<32.02
% of identified bone	25.9%	9.1%

t = 3.7
 p = <0.01
 Statistically significant

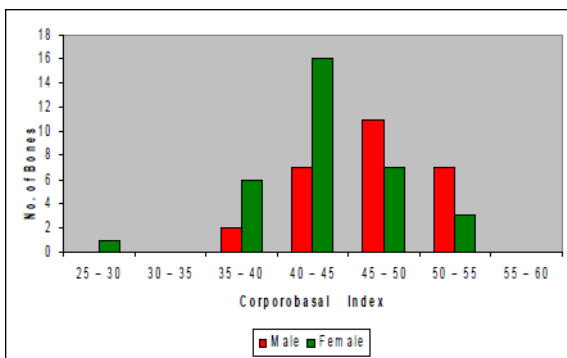


Figure 4: Corporobasal index.

Any single demarking point for any of the parameters, if crossed would detect the sex with 100% accuracy (Singh & Raju, 1980).

In discussion of every parameter an attempt has been made in the present work, to simultaneously compare with the other workers.

Mid-ventral straight length

Mean value for the mid ventral straight length in male is 113.9 mm and that for females is 90 mm. For male the demarking point is >117.39 mm, for female the demarking point is <79.31 mm. Sacrum with mid ventral straight length measuring above 117.39 mm is definitely a male and below 79.31 mm is definitely a female.

Present findings matched nearly with the findings of Mishra, S.R. et al (2003-07) S.N. Medical College, Agra, Uttar Pradesh.

It is evident that there exists a racial difference and regional (within the same country) difference in the length of sacrum.

Breadth (maximum transverse length) of sacrum in mm

Average value for the breadth (maximum transverse length) in males is 104.2 mm and that for females is 103.4 mm. For male the demarking point is <85.34 mm, for female the demarking point is >125.14 mm. Sacrum with width (maximum transverse length) measuring below 85.34 mm is definitely a male and above 125.14 mm is definitely a female width of sacrum in mm. Present findings matched nearly with those of Raju et al (1980) and Mishra, S.R. et al (2003-07).

Mid-ventral curved length

Mean value for the mid ventral curved length in males is 125 mm and that for females is 100 mm. For male the demarking point is >127.38 mm, for female the demarking point is <87.62 mm. Sacrum with mid ventral curved length measuring above 127.38 mm is definitely a male and below 87.62 mm is definitely a female.

Present findings matched nearly with the findings of Mishra, S.R. et al (2003-07) and Raju et al (1980).

Transverse diameter of body of first sacral vertebra in mm

Mean value for transverse diameter of body of 1st sacral vertebra in males is 48.7 mm and that for females is 44.9 mm. For male the demarking point is >62.06 mm, for female the demarking point is <29.47 mm. Sacrum with transverse diameter of body of 1st Sacral Vertebra measuring above 62.06 mm is definitely a male and below 29.47 mm is definitely a female.

Comparison of transverse diameter of body of 1st Sacral Vertebra (S₁) (in mms) with that of different workers.

Present findings nearly matched with those of Raju et al. (1980) and Mishra, S. R. et al. (2003-07).

Sacral index

Mean value for sacral index in males is 91.8% and that for females is 116.3%. Mean value of female is significantly higher than that of male. For male the demarking point is <87.77 mm, for female the demarking point is >106.77 mm. Sacrum with sacral index measuring below 87.77 mm is definitely a male and above 106.77 mm is definitely a female.

3.7% of male sacra and 9.1% female sacra do not overlap (Table 6) in the respective ranges in this parameter. In overlapping ranges the study of other bones in addition to, help in determination of sex with greater certainty. Mean value for male sacra is significantly higher than that in females. The sex difference in mean values of sacral index in male and female is statistically significant. The sex difference in mean values of sacral index in male and female is statistically significant.

Table 14 shows comparison of sacral index observed in studies of various workers. Present findings nearly matched with those of Mishra, S. R. et al (2003-07), S. N. Medical College, Agra, Uttar Pradesh.

In the European sacrum mean values of both male and female fall into the PlatyhiERIC group.

Curvature index of sacrum

Mean value for curvature index of sacrum in males is 90.8% and in females 90.1%. Demarking points for male and female sacra are calculated with the help of the calculated range. For male the demarking point is >102.82mm, for female the demarking point is <74.03 mm. Sacrum with curvature index above 102.82 is definitely a male and less than 74.03 is definitely a female.

96.3% of male sacra and 9.1% female sacra do not overlap (Table 9) in the respective ranges in this parameter. In overlapping ranges the study of other bones in addition to, help in determination of sex with greater certainty. Mean value for male sacra is significantly higher than that in females. The sex difference in mean values of curvature index of sacrum in male and female is statistically insignificant.

Table 17 shows comparison of curvature index of sacrum in others study. Present findings did not matched with those of Mishra, S. R. et al (2003-07), S.N. Medical College, Agra, Uttar Pradesh.

Corporobasal index of sacrum

Mean value for corporobasal index of sacrum in males is 46.6 mm and in females 42.9 mm. For male the

demarking point is >57.81 mm, for female the demarking point is <32.02 mm. Sacrum with corporobasal index above 57.81 is definitely a male and less than 32.02 is definitely a female.

Comparison of corporobasal index of sacrum observed in studies of various workers. Present findings nearly matched with those of Mishra, S.R. et al (2003-07), S.N. Medical College, Agra, Uttar Pradesh.

CONCLUSION

Five parameters were measured and three indices were calculated with the help of formulae.

With the help of statistician, the mean, calculated range, standard deviation, 't' value, 'p' value, demarking points and % of bone identified by demarking points were calculated for each parameter for all the bones under study.

After a detailed study and comparison of the present study with other studies, it could be concluded that demarking points help in sexing the sacrum with greater accuracy. The demarking points of 1. mid ventral straight length of sacrum, 3. midventral curved length of sacrum, 2. Max breadth of sacrum and 4. transverse diameter of body of S₁ among the measurements and the 5. sacral index, 7. corporobasal index, 6. curvature index among the indices were most reliable in sexing of sacra.

Table 8: From the present study the following results were obtained.

Sr. No	Parameters	Demarking point (in mm)	
		Male	Female
1.	Mid Ventral Straight length of sacrum	>117.39	<79.31
2.	Max breadth of sacrum	<85.34	>125.14
3.	Mid ventral curved length of sacrum	>127.38	<87.62
4.	Transverse diameter of body of S ₁	>62.06	<29.47
5.	Sacral index	<87.77	>106.77
6.	Curvature Index	>102.82	<74.03
7.	Corporobasal index	>57.81	<32.02

Based on the variations observed among the measurements within the sex as well as between sexes and between the two races, two countries and even within the regions of the same country, the demarking points of a single parameter may not identify sex in all the bones, but the accuracy is high in the bones which are identified. Hence to identify sex of the sacrum, maximum number of parameters should be taken into consideration to attain greater accuracy.

Table 9: Master chart.

Sr. No.	Length of sacrum (mm)	Width of sacrum (mm)	Curved length of sacrum (mm)	Tr. Dia. of body of 1st sacral vertebra.	Sacral index	Curvature index	Corporo-basal index
Male							
1	96.6	92.7	106	43.5	95.96	91.13	46.92
2	93.6	92.3	112	38.2	95.54	83.57	41.38
3	125.3	104.3	141	55.1	83.24	88.86	52.82
4	100.1	94.6	120	41.6	94.5	83.41	43.97
5	122.5	109.3	137	47.2	89.22	89.41	43.18
6	103.3	100.6	112	54.1	97.38	92.23	53.77
7	115.2	104.3	125	53.5	90.53	92.16	51.29
8	109.3	103.2	132	49.2	94.41	82.8	47.67
9	130	115.3	135	52.7	88.69	96.29	45.7
10	117.4	112.2	126	54.4	95.57	104.27	48.48
11	105.5	99.4	113	40.4	94.21	93.36	40.64
12	104.6	101.3	112	41.2	96.84	93.39	40.67
13	101.2	98.2	103	38.3	97.03	98.25	39
14	119.4	114.2	128	56.4	95.64	92.96	49.38
15	123.5	110.3	138	48.2	89.31	89.49	43.69
16	102.1	96.6	122	43.6	94.61	83.68	45.13
17	124.3	103.3	140	54.1	83.1	88.78	52.37
18	108.3	102.2	131	48.2	93.41	81.8	46.67
19	130	115.3	135	52.7	88.69	96.29	45.7
20	125.3	104.3	141	55.1	83.24	88.86	52.82
21	125.3	104.3	114	55.1	83.24	88.86	52.82
22	105.5	99.4	113	40.4	94.21	93.36	40.64
23	131	115.3	135	52.7	88.69	96.29	45.7
24	119.4	114.2	128	56.4	95.64	92.96	49.38
25	125.3	104.3	141	55.1	83.24	88.86	52.82
26	109.32	103.2	132	49.2	94.41	82.8	47.67
27	101.2	98.2	103	38.3	97.03	98.25	39

Sr. No.	Length of sacrum (mm)	Width of sacrum (mm)	Curved length of sacrum (mm)	Tr.Dia.of body of 1st sacral vertebra.	Sacral index	Curvature index	Corporo-basal index
Female							
1	92.2	103.6	102.6	45.6	112.36	90.39	44.01
2	96.1	100.7	113	48.6	104.78	85.04	48.26
3	84	94.4	93	36.7	112.38	90.32	38.87
4	85.1	95.5	96	39.1	112.22	88.64	27.43
5	81.8	97.3	95	42.3	118.94	86.1	43.47
6	103.6	110.7	118	44.9	106.85	87.79	40.56
7	104.1	111.1	107	47.5	106.7	97.28	42.57
8	98.4	104.2	100	47.5	105.89	98.4	45.58
9	94.5	115.5	105	48.5	122.22	90	41.99
10	106.8	108.7	108	46.6	101.77	98.88	42.87
11	82.5	108.2	100	56.5	131.15	82.5	52.21
12	93.1	107.5	105	50.6	115.46	88.66	47.06
13	93.7	102.5	103	47.3	109.39	90.97	46.14
14	78.14	96.4	88	40.3	129.56	89.09	41.8
15	80.2	102.5	87	37.5	127.8	92.18	36.58
16	91.7	100.5	101	45.3	109.59	90.79	45.07
17	83.5	109.2	101	57.5	130.77	82.67	52.67
18	93.2	104.6	103	46.6	112.23	90.48	44.55
19	83.5	109.2	101	57.3	132.15	83.5	52.65
20	79.4	97.4	89	41.3	122.67	89.22	42.4
21	80.21	102.5	87	37.5	127.8	92.18	36.58
22	103.6	110.7	118	44.9	106.85	87.79	40.56
23	84	94.4	93	36.7	112.38	90.32	38.87
24	104.1	111.1	107	47.3	106.72	97.28	42.57
25	78.42	96.4	88	40.3	129.56	89	41.8
26	103.6	110.7	118	44.9	106.85	87.79	40.56
27	98.4	104.2	100	47.5	105.89	98.4	45.58
28	84.1	94.4	93.1	36.7	112.38	90.32	38.87
29	81.81	97.3	95.01	42.3	118.94	86.1	43.47
30	92.22	103.61	102	45.6	112.36	90.39	44.01
31	93.11	107.5	105	50.6	115.46	88.66	47.06
32	78.42	96.42	88	40.3	129.56	89	41.8
33	82.21	104.5	89	39.5	127.11	92.37	37.79

Table 10: Showing statistical calculations of various parameters of the sacrum.

S. No	Parameters	Sex	N	Range	Mean	SD	't' value	'p' value	Calculated range mean \pm SD	D.P.	% of bone identified by D.P.
1	Max Length of sacrum (mm)	M	27	93.60 – 131.00	113.9	11.53	8.78	<0.01	79.31 to 148.49	> 117.39	74.1%
		F	33	78.14 – 106.80	90.0	9.13					
2	Max Breadth of sacrum	M	27	92.30 – 115.30	104.2	6.98	0.441	>0.05 NS	83.26 to 125.14	<85.34	0
		F	33	94.40 – 103.40	103.4	6.02					
3	Mid ventral curve length of sacrum	M	27	103.0 – 141.00	125.0	12.46	8.720	P< 0.01	87.62 to 162.38	.>127.38	63%
		F	33	87.00 – 118.00	100.0	9.07					
4	Tr Dia of Body of 1 st sacral vertebra	M	27	38.20 – 58.40	48.7	6.41	2.42	P < 0.05	29.47 to 67.93	>62.06	63%
		F	33	36.70 – 57.50	44.9	5.72					
5	Sacral Index	M	27	83.10 – 97.38	91.8	4.99	-12.8	P < 0.01	76.83 to 106.77	<87.77	3.7%
		F	33	101.77 – 132.15	116.3	9.51					
6	Curvature index	M	27	81.80 – 104.27	90.8	5.59	0.6	> 0.05 NS	74.03 to 107.57	>102.82	96.3%
		F	33	82.50 – 98.88	90.1	4.24					
7	Corporofasal index	M	27	39.30 – 53.77	46.6	4.86	3.0	P < 0.01	32.02 to 61.18	> 57.81	25.9%
		F	33	27.43 – 32.67	42.9	4.97					

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