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Research Paper | Medical Science

A Tool For Sex Identification

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ABSTRACT

As sacrum is a component of axial skeleton and because of its contribution to the pelvic girdle and in turn to the functional differences in the region between the two sexes, it has an applied importance in determining sex with the help of measurements carried upon it. Over the years, different workers have studied sexual dimorphism in adult human sacra belonging to different races and regions.For our study, 300 sacra (150 Male and 150 Female), were taken from the departments of Anatomy by visiting different Medical colleges in Maharashtra. The parameters were studied & indices were calculated. The demarking points (D.P.) of various parameters as well as indices were determined. The percentage of bones identified by (D.P.) was also recorded. The results were compared with the available literature. It was found that the ventral straight length and length of auricular surface amongst the parameters and sacral index and index of differential length of lateral surface of sacrum were more reliable in sexing the sacra as compared to other parameters and indices.

KEYWORDS: Sacrum, Sacral index, Index of body of (S1), Alar Index , Index of differential length of lateral surface of sacrum.

INTRODUCTION

Sexing of human skeletal remains is an ever challenging task for anatomists, forensic experts, paleo-demographers as well as the anthropologists12. The sexual dimorphism in human skeleton results from the adaptations of the female to the function of child bearing, the influence of sex hormones and cultural differences between the sexes.

In the determination of sex in human skeleton, statistical methods are more significant, than the visual morphological methods .The best indicators of sex in the skeleton are found in the pelvis.1

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 bone3.

Many western workers did extensive studies on sex differences in sacrum by using metrical analytical methods4,8,10. The available literature clearly shows that Indian sacra have not been studied extensively except few authors like Singh &Raju14 and Jana et-al6.

The present study was undertaken to analyze the sex differences in the sacra of Maharashtra population statistically & to define the utility of various parameter in determination of sex of the sacrum.

MATERIAL AND METHODS

For our study, 300 sacra (150 Male and 150 Female), were studied from the departments of Anatomy by visiting different Medical colleges in Maharashtra. Each sacrum was fully ossified and anomalies like sacralisation of lumbar vertebra were not included in the study. All the parameters were measured by the sliding vernier calliper. All the measurements were recorded in millimeters. Then, sex wise data was summarized into range (minimum- maximum), mean and standard deviation (S.D.). Student's 't' test (unpaired) was applied for the data and to calculate the demarking point (D.P.) 7 i.e. the point which will find whether the sacrum is of male or female, mean ± 3SD was calculated. However it was not necessary for any bone to cross the D.P.s of all the parameters before the sex could be identified. Any single D.P. for any of the parameters, if crossed would detect the sex with 100% accuracy14

Observations

Our observations for all the studied parameters & indices are given in table no. 3.

DISCUSSION

The ventral straight length is found statistically significant with higher values in males than in females. In 1963, Davinongs 3 explained a longer scrum in males by the fact that 6 piece sacra are more common in males. But in the present study no 6 piece male sacrum was found.

Our findings co-relate with most of the worker's who found a longer sacrum in males, but they are more closer with that of Mishra9 et-al & Siddiqui13. As like most of the workers in the past, we also found that the maximum width of sacrum was insignificant statistically; although in both the sexes its mean value was more than the findings of Davinongs3. The mean value of the antero-posterior diameter of was seen more in males which agree with most of the workers. A larger transverse diameter of S1 vertebra as in our study was attributed by Francis5 to a larger articular facet for body of L5 in them occupying up to 1/2 of breadth of sacrum. In females, the facet is smaller occupying hardly upto 1/3rd of breadth of sacrum. But neither of them can be used independently to separate any female sacrum from male sacrum.

The mean values of length of alae, length of non -auricular part of lateral surface of sacrum, were more in the females, whereas those of anteroposteior diameter of S1, length of auricular part of lateral surface of sacrum were more in the males.

Amongst the indices, the index of body of S1 vertebra, the alar index are weaker whereas the sacral index & the index of differential length of lateral surface of sacrum were the most useful criteria for sex identification.

In contrast to Davinongs3 in Australian aborigines and Raju et-al11in Varanasi region, who found the index of body of Ist sacral vertebra statistically insignificant, our study reveals a highly significant difference in this index in both the sexes.

SUMMARY AND CONCLUSION

The value of determining the sex of sacrum, which forms a part of pelvis, is mostly medico legal where 100% accuracy is required.

The knowledge of sex differences in the sacrum can give a useful clue as regards the implementation of orthopedic instruments in the correction of spine instability due to degenerative and traumatic conditions2.

Continuation of such studies in a defined geographic area over a period of time will definitely help in establishing the anthropometric standards.



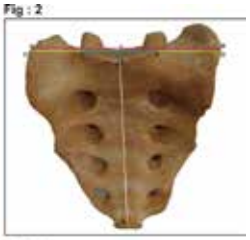





Table 1: Defining various Sacral parameters measured in the present study

Sr No.	Parameters(cm)	Method of measurement	Shown in fig 2. as the distance between points
1	Length of sacrum	From the mid-point of sacral promontory to the mid-point of antero–inferior margin of last sacral vertebra.	A & B
2	Width of sacrum	Transverse breadth across the base of sacrum.	A′ & B′
3	Tra.Dia.Of S1	Each side of lateral most point on superior surface of body of Ist sacral vertebra.	C & D
4	A.P.Dia.Of S1	From mid- point of sacral promontory to mid-point of postero-superior border of the Istsacral vertebra.	E & F
5	Length of Alae	Across the lateral most point on superior surface of body of Istsacral vertebra & another point on lateral most part of each ala.	C-C′&D- D′
6	Length of auri.partof latsuface.	From a point on the upper most part of auricular surface to another point on the lower most part of the auricular surface.	Shown in fig 3. as the distance between points G & H
7	Length of NON auri.part of lat. Surface.	From upper point on non- auricular part and a point at the end of lateral border of sacrum.	Shown in fig 4. as the distance between points G′ & H′

Table 2: Defining various Indices of Sacrum studied in the present study

Sr No.	Index	Calculated as
1	Sacral Index	Width of Sacrum ---------- X 100 Straight length
2	Index of body of S1	Antero Posterior diameter of Body of S_1 ----------X 100 Transverse diameter of Body of S_1
3	Alar index	Length of Alae ---------- X 100 Transverse diameter of Body of S_1
4	Index of Diff. Length of lat. Surface.	Length of articular(upper) part of lateral surface ---------- ------- X 100 Length of non- articular(lower) part of lateral surface

TABLE 3 Observations of Present Study on Sacrum

Sr No.	Parameter	Sex	Range	Mean	S.D.	't' Value	P Value	D.P.	%of bones Id.by D.P.
1.	Length of sacrum	M	89-123	107.41	5.62	17.82	<0.001	>118.1	39
		F	68-119	92.57	8.51			<90.55	27
2	Width of sacrum	M	90-118	101.15	5.4	1.578	>0.05	-	-
		F	87.5-116.6	104.12	5.93				
3	Tra.Dia. Of S1	M	36.1-57	46.78	3.96	7.411	<0.001	>56.88	20
		F	31.6-54	43.11	4.59			<34.9	0
4	A.P. Dia. Of S1	M	20.4-53.5	29.6	3.21	3.574	<0.001	>36.11	1
		F	22-38	28.4	2.57			<19.97	0
5	Length of alae	M	22.5-38.3	29.74	2.99	3.040	<0.01	<22.16	1
		F	22.7-38.5	30.77	2.87			>38.71	4
6	Length of auri.part of lat.surface	M	43.4-64.25	54.65	3.82	17.395	<0.001	>58.47	17
		F	36.8-56.2	46.95	3.84			<43.17	16
7	Length of non auri. part of lat. surface	M	38.8-59.5	48.56	4.28	7.198	<0.001	<39.82	1
		F	40.1-64	52.03	4.07			>61.4	2
8	Sacral index	M	89-112.15	97.94	2.6	18.523	<0.001	<83.99	2
		F	97.9-145.9	113.18	9.73			>105.74	70
9	Index of body of s1	M	47.22-100	63.61	7.6	3.233	<0.001	<44.92	2
		F	51-95	66.37	7.15			>86.41	22
10	Alar index	M	44.2-94.46	64.22	9.9	6.611	<0.001	<38.66	0
		F	49,4-111.55	72.29	11.21			>93.92	5
11	Index-diff. length of lat.surface.	M	93-157.7	113.23	11.56	20.255	<0.001	>112.72	40
		F	63.3-100.5	90.52	7.4			<78.55	8

Table 4: Comparison of Sacral parameters with different Authors.

Sr. No.	Au-thors- Param-eter in	Davinongs 1963		Raju et al 1980		Siddiqui2000		Mishra et al 2003		Sachdev et al 2007		Present study 2008	
		M	F	M	F	M	F	M	F	M	F	M	F
1	mm. Straight length	96.5	88.1	105	92.7	104.9	91.1	107.5	90.6	104.1	91.8	107.4	92.57
2	Maxi-mum breadth	99.9	101.1	105.3	103	102.9	103.9	105.34	105.8	111.8	104.4	101.15	104.1
5	Tra. Dia. Of S1	47.4	44.1	47.3	42.1	49.2	42.4	49.1	42.8	47.6	45.5	46.8	43.11
4	A.P.Dia. of S1	29.7	27.5	30.3	27.6	29.5	27.7	30.04	29.2	31.5	28.5	29.6	28.4
5	Length of alae	-	-	-	-	28.9	31.9	28.38	31.67	33.5	30	29.74	30.77
6	Length of auri Part of lat surface.	-	-	-	-	-	-	62.54	54.57	-	-	54.65	46.95

7	Length of non. auri. part of lat. Surface	-	-	-	-	-	-	-	-	-	-	48.56	52.03
8	Sacral index	104.6	114.5	100.85	111.39	98.37	114.73	98.21	117.8	100.21	111.74	97.94	113.2
9	Index of body of S1	63.03	62.84	64.42	65.52	60.29	65.56	61.73	68.6	-	-	63.6	66.37
10	Alar index	-	-	62	72.4	58.9	75.98	56.1	72.6	-	-	64.2	72.29
11.	Index of Diff. length of lat. surface.	-	-	-	-	-	-	-	-	-	-	113.23	90.52

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