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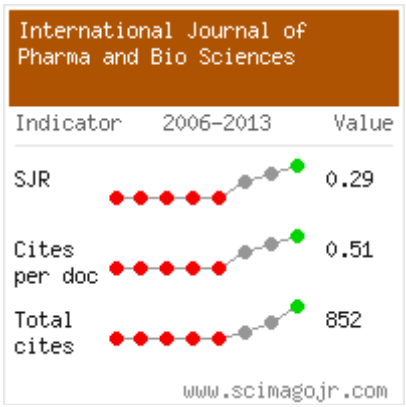

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SEXUAL DIMORPHISM OF THE SACRUM IN SOUTH INDIAN POPULATION USING MRI

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ABSTRACT

MRI plays a significant role in modern forensic anthropology to solve certain queries of legal / public concern. The objective of our study was to determine the sexual dimorphism of the first sacral vertebra (S1) in south Indian adults and to compare the differences in sacrum measurement of south India with literature. MRI of lumbo-sacral region was performed on 25 male and 25 female patients who were referred by treating doctor. Measurements were performed on T2 weighted mid-sagittal image. The dimensions measured were anterior height (AH), posterior height (PH), Superior diameter (SD) and inferior diameter (ID) of body of first sacral vertebra. The mean of AH, PH, SD and ID in male was 28.164±2.05 mm, 21.988±2.60 mm, 31.924±2.28 mm, 20.096±3.34 mm and in female it was 28.896±3.28 mm, 20.868±2.59 mm, 30.224±1.57 mm, 17.7±3.27 mm respectively. Also the mean lumbo-sacral angle (LSA), sacral base angle (SBA) and anterior sacral angle (ASA) were also measured which were 53.24±6.48º, 38.6±6.65º and 61.52±7.04º for male respectively and in female it was 61.28±8.68º, 41.8±6.07º and 55.2±9.07º respectively. Also the Indices (Index 1 and index 2) were calculated. The mean of Index 1 and Index 2 in male was 63.069±10.318 and 78.291±9.179 and in female it was 58.534±9.979 and 72.527±7.648 respectively. The measurements of S1 showed higher values in males than female in all of the investigated parameters, except for Anterior Height, lumbo-sacral angle & Sacral base angle. Therefore the body of the first sacral vertebra (S1) is found to be highly significant for determination of sex.

KEYWORDS: Lumbo-sacral angle, sacral base angle, Forensic Anthropology

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INTRODUCTION

Forensic anthropology is the application of archaeological techniques and method to the medico-legal field, normally the enforcement of criminal law. It includes collecting, preservation and analyzing the samples of skeletal remains. Morphological changes in the skeleton of adults can be important indicators of sex and have been used extensively in forensic anthropology and bio-archaeology[1]. This study has a significant role in forensic radiology for sex determination and regional studies are constructive in the observation of the anthrometric trends which may be influenced due to environment, racial or genetic factor. Study of human skeleton has been excellent material for sex dimorphism. Krongman ranks accuracy of sex determination using the pelvis at 95%, the skull at 90%, the pelvis and the skull at 98% and long bones at 80% [2]. The pelvic girdle is the most sexually dimorphic region of skeleton, and it can be used to determine sex with a high degree of accuracy. Sacrum is the part of pelvic girdle forming the base on which the entire vertebral column is erected. Difference between men and woman includes all the features related to reproductive role, notably the endocrine system and their physical, psychological and behavior effects. MRI is a multiplainar advance imaging modality which provides excellent contrast resolution with minimum magnification error. It plays a significant role in modern forensic anthropology. We used mid sagittal MRI images for measurements of the S1 vertebra to obtain precise data for assessment of sexual dimorphism in south Indian population and to compare with literature.

METHODS

Approval was acquired from ethical committee, Kasturba Hospital and institution research committee, School of Allied Health Sciences. It is a perspective observational study, carried out at Department Of Radio-diagnosis and Imaging, Kasturba Hospital, Manipal, Karnataka using 1.5 T GE MRI. Samples collected were 50, equally distributed to 25 males and 25 females of age group between 20-60 years who were referred by treating doctor for MRI of lumber sacral spine. MRI scan of the lumber sacral region was performed using routine sequences. Measurements were performed in T2 weighted mid-sagittal image. Metric data from body of the first sacral vertebra (S1) were collected in millimeters which includes AH, PH, SD and ID. To avoid magnification error of imaging, Index 1 (ID/SD X 100) and Index 2 (PH/AH X 100) were calculated. The angles of S1 vertebra were also measured in degree which includes SBA, LSA and ASA. The obtained data of the S1 were statistically analyzed using Independent T-test.

Table I

Definition of anatomic parameters of the body of the first sacral vertebra (S1)

Sl. No	Parameters	Abbreviation	Definition
1	Anterior height	AH	The maximum distance between superior and inferior limits of the anterior border of S1 vertebral body at the mid-sagittal plane.
2	Posterior height	PH	The maximum distance between superior and inferior limits of the posterior border of S1 vertebral body at the mid-sagittal plane.
3	Superior diameter	SD	The maximum distance from anterior to posterior limits of the superior border of S1 vertebral body at the mid-sagittal plane.
4	Inferior diameter	ID	The maximum distance from anterior to posterior limits of the inferior border of S1 vertebral body at the mid-sagittal plane.
5	Sacral base angle	SBA	The angle between the superior border of S1 vertebral body and the horizontal line.
6	Lumbosacral angle	LSA	The angle between the anterior border of S1 vertebral body and that of the 5th lumbar vertebra.
7	Anterior sacral angle	ASA	The angle between the superior and anterior borders of S1 vertebral body.

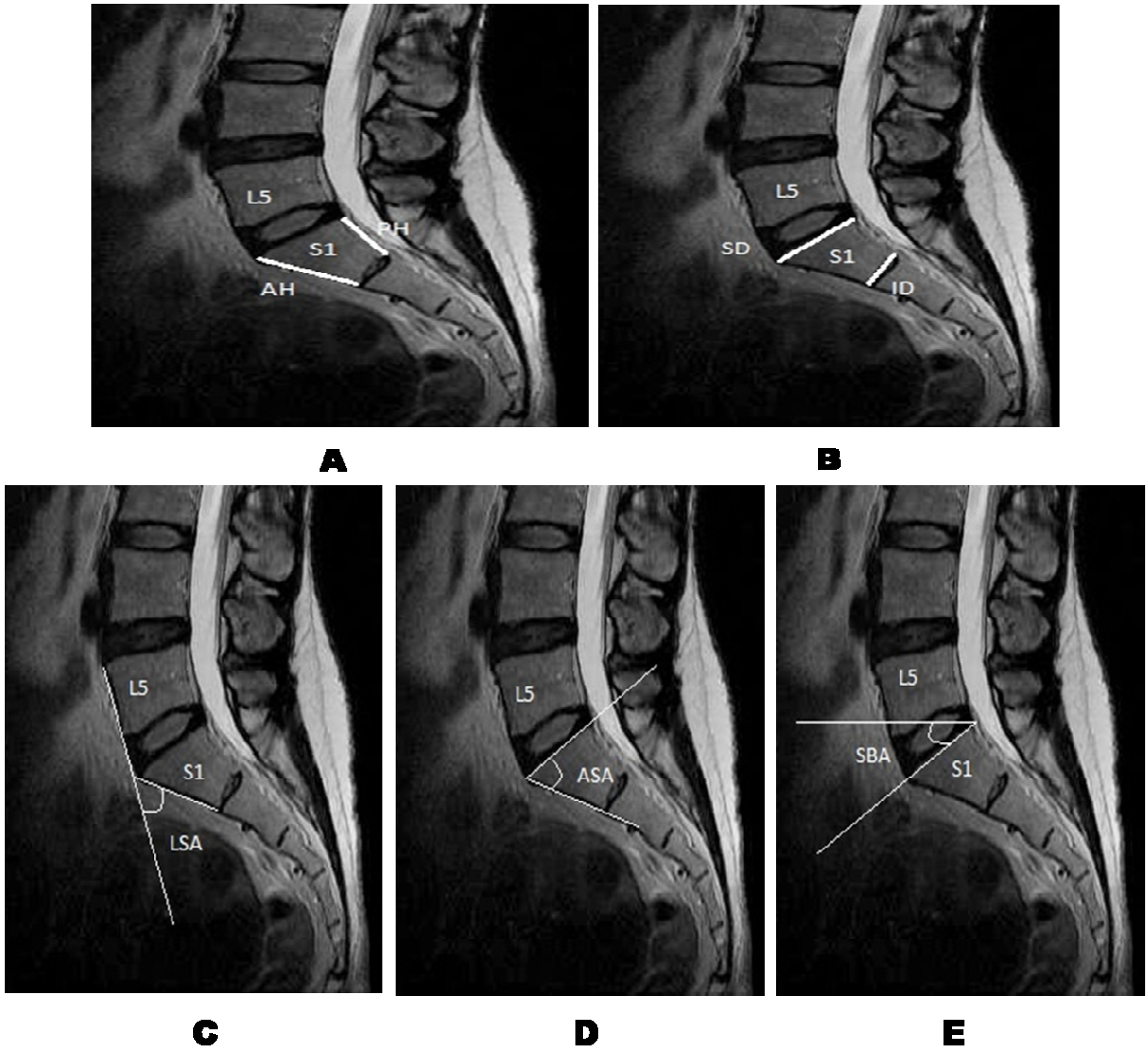

Figure I

Mid-sagittal MRI images identifying: A) Anterior height (AH) and Posterior height (PH), B) Inferior diameter (ID) and Superior diameter (SD), C) Lumbosacral angle (LSA), D) Anterior sacral angle (ASA), E) Sacral base angle (SBA)

RESULTS

The investigated data is summarized in table II. The mean of AH, PH, SD and ID in male was 28.164±2.05 mm, 21.988±2.6 mm, 31.924±2.28 mm, 20.096±3.34 mm and in female was 28.896±3.28 mm, 20.868±2.59 mm, 30.224±1.57 mm and 17.7±3.27 mm respectively. Among these parameters AH is found to be larger in females while all the other parameters are larger in males (Figure II). SD and ID are found to be statistically significant parameters as their P-values are less than 0.05, whereas AH and PH are not found to be statistically significant for sex determination. The calculated Indices (Index 1 and index 2) were found to be smaller in females as compared to males (Figure III). The mean of Index 1 and Index 2 in male was 63.069±10.31 and 78.291±9.17 respectively and in female was 58.534±9.979 and 72.527±7.648 respectively. Index 2 was found to have higher statistical significance since it has the P-value of less than 0.05. The values of the investigated angles also differed between males and females. The mean of LSA, SBA and ASA in

male was 53.24±6.48º, 38.6±6.65º and 61.52±7.04º and in female it was 61.28±8.68º, 41.8±6.07º and 55.2±9.07º respectively. Among these investigated angles LSA and SBA were found to be larger in female than in male. But the measurement of ASA was larger in male than in female (Figure III). The difference between LSA and ASA of males and females were considered to be statistically significant, but the sex difference in SBA was not found to be statistically significant.

Table II

Statistical Analysis of the Investigated Measurement and Indices in Male &Female

	Males (no. 25)			Females (no.25)			MGD	SE	CI	P-value
	Mean	SD	Range	Mean	SD	Range				
AH (mm)	**28.164**	**2.055**	**23.8-31.3**	**28.896**	**3.282**	**22.8-33.6**	**0.732**	**0.775**	**0.826 to2.290**	**0.349**
PH (mm)	21.988	2.603	18.5-27.0	20.868	2.592	16.3-27.6	1.123	0.735	0.357to2.597	0.134
SD (mm)	31.924	2.285	26.1-36.0	30.224	1.570	27.2-33.5	1.700	0.555	0.585to2.815	0.004
ID (mm)	20.096	3.342	15-28	17.7	3.276	14.8-28.4	2.396	0.936	0.514to4.278	0.014
Index 1 (ID/SDx100)	63.069	10.318	50.6-87.5	58.534	9.979	48.9-87.3	4.535	2.871	1.238to10.307	0.121
Index 2 (PH/AHx100)	78.291	9.179	63.7-92.7	72.527	7.648	63.0-90.7	5.764	2.390	0.960to10.569	0.020
LSA	53.24	6.488	39-64	61.28	8.681	42-73	8.040	2.168	3.681to12.399	0.001
SBA	38.6	6.658	20-50	41.8	6.075	26-51	3.200	1.803	0.425to6.825	0.082
ASA	61.52	7.042	53-76	55.2	9.078	41-81	6.320	2.298	1.700to10.940	0.008

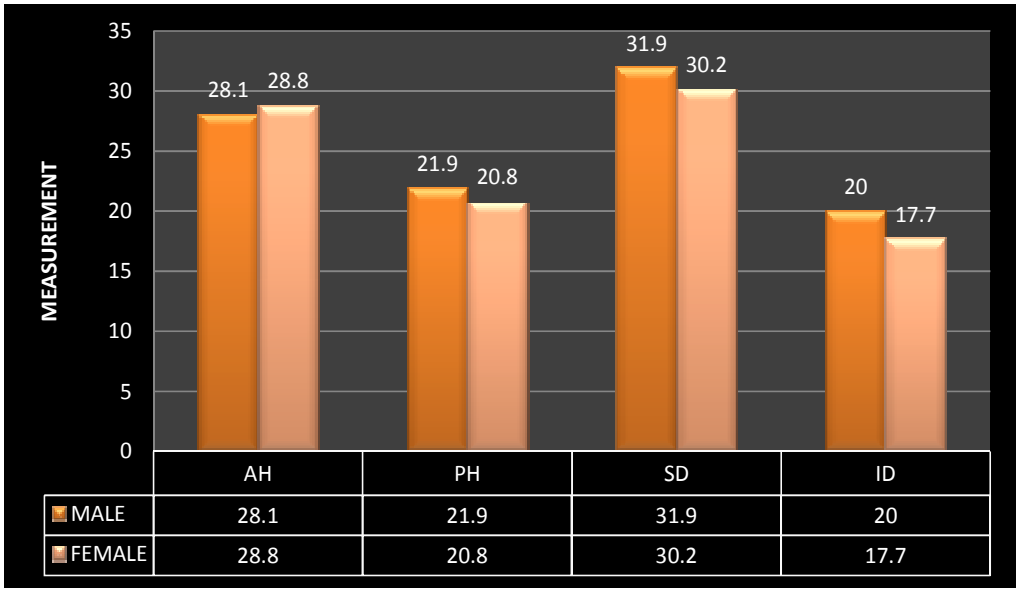

Figure II

A histogram showing the mean measurements of first sacral vertebra(S1)

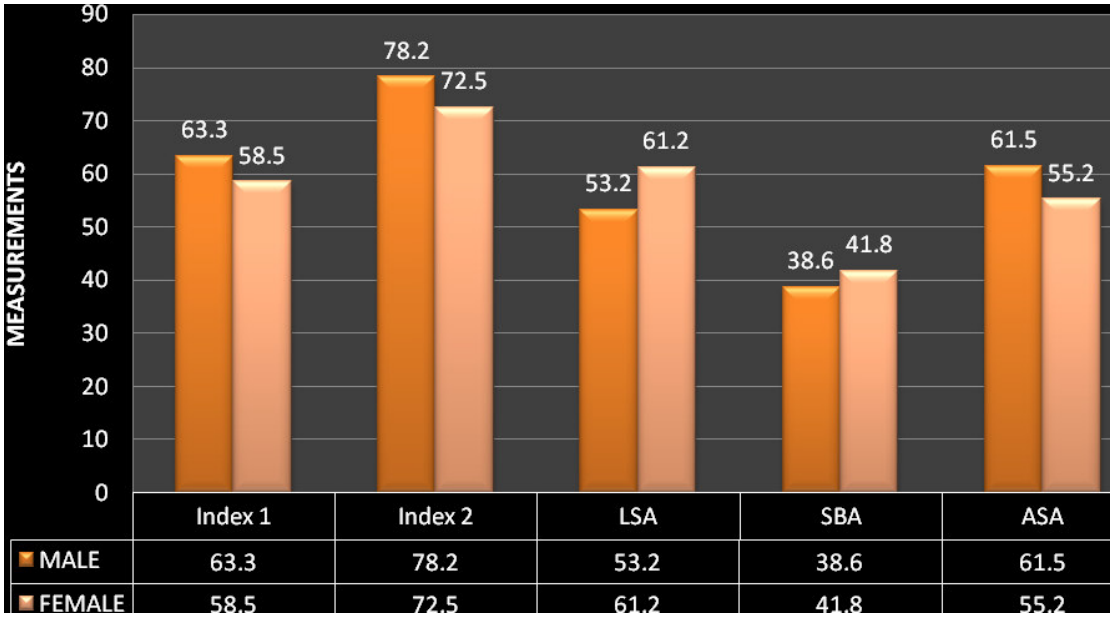

Figure III

A histogram showing the mean data of the indices and angles at first sacral vertebra(S1)

DISCUSSION

Sacrum is the part of pelvic girdle, reflecting its sexual dimorphism, as Krongman ranks accuracy of sex determination using the pelvis at 95%. Plochocki[3] conducted a study on sexual dimorphism of anterior sacral curvature on 125 dry sacral bones. He measured various parameters describing the anterior sacral curvature, and found that the sacral curvature was significantly greater in males than in females. Similar result was found in present study where almost all the investigated parameters were larger in males then in females except for Anterior Height which was found to be greater in females. Basaloglu et al.[4], performed a study on Morphometric of sacrum for clinical use with 60 dry adult sacrum. In their study they reported a slight difference in SD measurements between males with the mean of 32 mm and females with the mean of 30mm. Similar finding was reported by Abdelmonem[5] but his finding was slightly larger (mean in male: 34mm; mean in female: 31 mm). This small difference is consistent with that recorded in the present study, where the measurement is similar with that reported by Basaloglu et al. Mishra et al.[6,] performed a study on Identification of sex of sacrum of Agra region with 116 adult sacra of known gender. The parameters measured was the maximum length of sacrum, maximum breadth of sacrum, curved length of sacrum, anterior-posterior diameter of the body of S1 vertebra, transverse diameter of the body of S1 vertebra, length of alae and maximum length of auricular surface. Similarly, Sibani et al.[7,] in their study on sexual dimorphism and regional difference in size of sacrum in Eastern India done on 250 normal adult sacra used same parameters and reported that almost all the parameters were higher in males than females except width of sacrum and length of ala of sacrum. This result was similar with the present study. The parameters used by these authors are different than the parameters used in this current study as those measurements were done in dry bones. Only one parameter, anterior-posterior diameter (SD) of the body of S1 vertebra is similar. While taking this parameter into consideration, the mean measurement taken by Mishra et al.[6], in Agra region was 30.04±2.58 mm for males and 29.29±2.15 mm for females, also in the mean measurement taken by Sibani et al.[7], in eastern India was 29.4±3.8 mm for males and 27.9±2.7 mm for females, which

shows that the male measurement are higher than female. Similar result was observed in the current study where the SD measurement for male was higher with the mean of 31.92±2.28 mm than female with the mean of 30.22±1.57 mm. It was observed that mean measurement is variable depending upon the region. As reported by Sibani M et al.[7], and Mishra et al.[6], there is difference in the mean measurement of sacrum depending on environmental, racial and genetic factors of the region. Raju et al. (1981) reported that the mean length of male sacra of Agra region (107.53 mm) is higher than that of Varanasi region (104.96 mm). Comas and charls (1960) reported a wide variation in Chinese, Negroes and Bushmen sacrum measurement. All the above study was performed using dry bones and their parameters used was different. There are limited studies done using MRI, the result found in the present study showed difference in mean measurements when compared with the study done by Abdelmonem[5] in Egypt where the anterior height and posterior height and anterior-posterior diameter(SD & ID) was larger in Egypt population to that of South India. In order to avoid magnification error of imaging, we converted the metric data of S1 in ratio or indices. This concept was followed by Abdelmonem et al., in his study. Out of the investigated parameters of sacrum, three mean parameters yielded extremely significant differences between the two sexes with the great difference in the mean between two groups, these were LSA(mean group difference: 8.040), ASA (mean group difference: 6.320) and index 2 (mean group difference: 5.764). The LSA in the current study was found to be lesser in males with the mean of 53.24±6.48˚ than females with the mean of 61.28±8.68˚ where as ASA was found to be lesser in females with the mean of 55.2±9.07˚ than males with the mean of 61.5±7.04˚. Similar result was observed by Abdelmonem et al[5]. In summary, the magnitude of sexual dimorphism in investigated parameters, indices and lumbosacral and anterior sacral angles at S1 ranks these measures among the most highly dimorphic of the pelvis.

CONCLUSION

The body of the first sacral vertebra (S1) is highly significant for determination of Sex as almost all the parameters are larger in males than females. Also the indices drawn from the ratio of anterior height and posterior height, and superior diameter and inferior diameter of S1 Vertebra can be used for sex determination. It has an immense importance's in Forensic Medicine and anthropology. This study also indicates that there is a regional difference in the measurement of S1 vertebra depending on the environmental, racial and genetic factors of the region.

REFERENCES

1. Ravichandran D., Shanthi K.C., ShankarK.,Harinath Chandra. A Study on Sacral Index in Tamil Nadu and Andhra Pradesh Population of Southern India. Journal of Clinical and Diagnostic Research, 7(9): 1833-1834, (2013)
2. Vick, Robbins, Smith. “A Laboratory Manual of Methods and Techniques in Physical Anthropology”. Learning Ace, Accessed on “31 March 2015”. http://www.learningace.com/doc/1275551/fd7e069505228ba42dab114b8cbc2fd0/humanskeletonnotes
3. J. Josh Snodgrass. Sex determination and aging of the vertebral column. Journal of Forensic Sciences, 49(3): 458 – 463, (2004)
4. Başaloğlu H, Turgut M, Taşer FA, Ceylan T, Başaloğlu HK, Ceylan AA. Morphometry of the sacrum for clinical use. Surgical and Radiologic Anatomy, 27(6): 467–71, (2005)
5. Abdelmonem Awad Hegazy. Sex Assessment of the First Sacral Vertebra, MRI Study. Journal of American Science, 9(10): 146 – 150 (2013)

6. Mishra SR, Singh PJ, Agrawal AK, Gupta RN. Identification of Sex of Sacrum of Agra Region. Journal of the Anatomical Society of India, 52(2):132-6, (2003).
7. Sibani Mazumdar, Ansuman Ray, Ardhendu Mazumdar, Sudeshna Majumdar, Abhik Sinha and Sanjoy Vasisht. Sexual Dimorphism and Regional Difference in Size of Sacrum: A Study in Eastern India, Al Ameen Journal of Medical Science,5 (3) :298 - 307, (2012)
8. Lauren m. Novak. "Sexual dimorphism of the posterior pelvis of the Robert J. Terry anatomical collection and William M. Bass donated skeletal collection".. University of Central Florida Anthropology, Accessed on "31 March 2015". http://anthropology.cos.ucf.edu/main/wp-content/uploads/2012/08/Novak_Lauren_M_201005_MA.pdf
9. Benazzi S, Maestri C, Parisini S, Vecchi F, Gruppioni G. Sex assessment from the sacral base by means of image processing. Journal of Forensic Sciences, 54(2): 249–54, (2009)
10. Stradalova V. Determination of sex from metric characteristics of the sacrum. Folia Morphologica, 22:408–12 (1974)
11. Gaurav Jindal, Bryan Pukenas. Normal Spinal Anatomy on Magnetic Resonance Imaging. Magnetic Resonance Imaging Clinics of North America, 19 (3): 475–488, (2011).
12. VasanthaMaddikunta, M. Ravinder. Morphometric study of sacrum in sex determination in Telengana region people. International Journal of Research in Medical Sciences, 2(1):164-174, (2014)
13. Mamatha H., Sandhya, Sushma R.K., Suhani S., Naveen Kumar. Significance of various sacral measurements in the determination of sex in south indian population. International Journal of Current Research and Review, 4 (20): 112 - 118, (2012).