

A Study on Sacral Index in Tamil Nadu and Andhra Pradesh Population of Southern India

RAVICHANDRAN D.¹, SHANTHI K.C.², SHANKAR K.³, HARINATH CHANDRA⁴

ABSTRACT

Introduction: Human sacral bones are of great interest to the anatomists, forensic experts and anthropologists as it is one of the important bones used for identification of sex in skeletal remains. Various parameters and indices are available based on which the sex can be determined using sacrum. One such important parameter is the SI. Studies shows that SI significantly varies among male and female gender and among different populations. The calculation of Demarcation Point (DP) of SI increases the accuracy of identification of sex. A review of literature showed that many studies are available in the North Indian population whereas there is a dearth of information about the normal SI and DP in South Indian population particularly in the Tamil Nadu and Andhra Pradesh, India region. Therefore, the present study aims to create a database for the SI in the above mentioned population.

Material and Methods: 123 bones of known sex (63 males and

60 females) belonging to Tamil Nadu and Andhra Pradesh, India region were studied. Bones with obvious pathology were excluded. The breadth and length of the sacra were measured using vernier calipers based on standard guidelines. The SI and DP were calculated. The statistical analysis was done using SPSS 15.0 package.

Results: The mean SI for male and female sacra were found to be 96.32 + 5.40 and 102.92 + 4.00 respectively. The Demarcating Point was found to be <90.29 in males and >112.43 in females. The mean length of male and female sacra was 97.8 mm and 90.6mm respectively. The mean width was 93.7mm and 92.91mm respectively for males and females.

Conclusion: The average SI and DP identified in the present study would be of use to the anatomists, forensic experts and anthropologists of Tamil Nadu and Andhra Pradesh population.

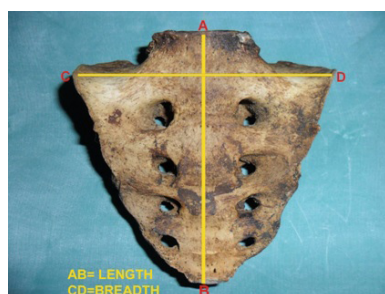
Key words: Sacrum, Sacral index, Population, Demarcation point

INTRODUCTION

Sacral Index (SI) is one of the important indices used to identify the gender of the bone. The SI is computed by multiplying the width of the sacrum by 100 and dividing it by the height (length) of the sacrum. In women the breadth of the sacrum as a rule is longer than the height when compared to men. Therefore, the SI also differs between men and women and hence it is used as a parameter to identify sex. However identification of sex using observations on multiple bones using different parameter is recommended than using a single bone [1-3]. The geometry of sacra (length and breadth) also varies among different populations leading to variations in average SI among different populations [4,5]. Calculation of Demarcating Point (DP) [6] for the parameters used in sex identification increases the accuracy by 100% and DP was calculated for each and every population [7] to get accurate results in the process of identifying the sex. To our knowledge studies on SI correlating its significance in identification of sex in the South Indian population is scarce and hence this study is undertaken to delineate the average SI and the DP of the Tamil Nadu and Andhra Pradesh population.

MATERIALS AND METHODS

The data for the present study comprised of 123 sacra of known sex



[Table/Fig-1]: Shows the points of measurement of Length and Breadth of Sacrum

(63 males and 60 females) from the bone banks of VMKV Medical College, Salem, Tamil Nadu, Annapoorana Medical College, Salem, Tamil Nadu, Vinayaka Pharmacy College, Salem, Tamil Nadu and Narayana Medical College, Nellore, Andhra Pradesh. Bones with any obvious pathology including fractures, developmental anomaly, damage due to storage and conservation were excluded from the study. The length and breadth of male and female sacra were measured separately using vernier calipers based on standard guidelines [8]. The length [Table/Fig-1] was measured along the midline from antero-superior margin of the promontory to the middle of antero-inferior margin of last sacral vertebra. The breadth [Table/Fig-1] was measured between the lateral most points of ala of sacrum. The readings were tabulated. The statistical analysis including mean SI, Demarcating Point (mean + 3 S.D.) [6] and test of significance between male and female was done using SPSS 15 version.

RESULTS

The mean SI for male and female sacra were found to be 96.32 (S.D = 5.40) and 102.92 (S.D=4.00) respectively. The Demarcating Point was found to be <90.29 in males and >112.43 in females. The student "t test" for significance of difference between male and female values showed highly significant difference ($p < 0.0001$). The mean length of

Sex	Mean Length (mm)	Mean Breadth (mm)	Mean Sacral Index	Range of Sacral Index	S.D of Sacral Index	p value of t test	Calculated range mean + 3 S.D	D.P for Sacral Index
Male	97.8	93.7	96.32	80.7 – 106.4	5.40	<0.0001	80.03-112.43	<90.29
Female	90.96	92.91	102.29	93.1 – 108.8	4.00		90.29-114.29	>112.43

[Table/Fig-2]: C Shows average length, breadth, sacral index and DP for males and females

male and female sacra was 97.8 mm and 90.6mm respectively. The mean width was 93.7 mm and 92.91mm respectively for males and females. The results are tabulated in [Table/Fig-2].

DISCUSSION

Human sacral bone is one of the important bones used for identification of gender. Various parameters of the sacrum including its length, breadth, curved length, AP and Transverse diameter at the level of S1, length of ala, auricular surface and indices like sacral index, curvature index, alar index, corporo basal index are used to identify the sex. A review of literature showed that not many studies are available in quotes the normal geometrical values (Sacral Index and Demarcating Point) of the South Indian sacra belonging to Tamil Nadu and Andhra Pradesh, India region. The present study is attempted to create a database of the above mentioned parameters in the said population.

A comparison between the males and females showed that the mean length of the male sacra was found to be higher than that of the female sacra in the present study [Table/Fig-2]. In general most of the studies done in various populations showed that the length of male sacra is higher than the length of the female sacra [2,4,9]. Increased incidence of six piece sacrum in males is proposed to be the cause for the increased length [4]. However six pieced sacra in males were not observed by others [9]. In present study six pieced sacrum in males was not observed.

The average breadth in males was found to be significantly higher in the study by Kanika et al., [9], Devivongs et al., [4] and Mishra et al., [2] in contrary to the results of Jyothinath et al., [10] where the breadth of female sacra is found to be higher. Our study showed that the average breadth of female sacra was lesser than that of the males but the difference was very negligible (0.8 mm).

In general, the average length and breadth observed in the present study was found to be lesser than the average length and breadth as observed by other authors [1,2,9,10,11].

The mean SI in the present series (Tamil Nadu region) for males is found to be 96.32 ± 5.40 . A comparison of our results with the other authors showed that our results were almost similar to the results of Patel et al in Saurashtra region (96.2), Mishra et al., [2] in Agra region (98.21) and Aurora et al in Punjab region (93.68) whereas it is lesser than the mean as observed by other authors like Mamatha et al., [12] (115.92) and Jyothinath et al., [10] in Karnataka region (104.84). Based on our results we classify the male sacra of the Tamil Nadu region under Dolichoheiric category (narrow sacra with SI <100).

In the females the mean SI is found to be 102.92 ± 4.00 in the present series. The female values for SI as observed by Patel et al., [1] (113.25), Mishra et al., [2] (117), Arora et al., [11] (125.35), Mamatha et al., [12] (125.02) and Jyothinath [10] et al., (115.7) are higher when compared to our study. We classify the female sacra of the Tamil Nadu region under Hyplatycheiric category (medium sacra with SI 100–105.9). Whereas the other authors [1,2,9,10,12] classify the female sacra under Platycheiric category (broad sacra with SI more than 106). Flander [13] reported the average SI in white males was 106.49 and 108.69 in white females. In blacks he reported the average was 106.17 in males and 112.35 in females. Thus from the above discussion it is clear that the average SI varies among different populations.

The present study showed that the difference between male and female average SI was statistically significant ($p < 0.0001$). Sacral index can be used with 95% accuracy in identification of sex [10]. Also due consideration has to be given to the fact that there is a variation of SI among different populations due to difference in length and breadth of the sacra. Studies show that the DP range for any parameter increases the reliability in identification of sex and it is important that DP be calculated for each and every population for accurate identification of sex in that particular population [1,2,14, 15]. The Demarcating Point ($3 + SD$) for SI in the present series was <90.29 in males and >112.43 in females. The estimation of DP therefore is of great medico legal importance. A data base for the average sacral indices of each and every population and a knowledge of DP is a must for identification of sex from the skeletal remains.

CONCLUSION

The present study showed a significant difference among the average male and female sacral indices and considers SI as a valuable parameter in identification of sex. The male and female sacra of the studied population are classified under dolichoheiric and hyplatycheiric category respectively. The average SI and DP identified in the present study would be of use to forensic experts, anthropologists and anatomists of Tamil Nadu and Andhra region. The authors recommend future studies with larger sample size.

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PARTICULARS OF CONTRIBUTORS:

1. Associate Professor of Anatomy, Narayana Medical College, Nellore, Andhra Pradesh, India.
2. Associate Professor of Anatomy, VMKV Medical College, Salem, Tamil Nadu, India.
3. Assistant Professor of Community Medicine, VMKV Medical College, Salem, Tamil Nadu, India.
4. Post graduate, Department of Anatomy, Narayana Medical College, Nellore, AP, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. D. Ravichandran,
B-202, Paavani Supreme Apartments, Krishna Mandir Road, Harnadapuram, Nellore, Andhra Pradesh, India.
Phone: (0)8501004340, E-mail: drravianatmd@gmail.com

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