

## Study of Sacral Index: Comparison between Different Study

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### Abstract

**Introduction:** Identification of sex by human skeletal remains is very important in anthropological and medico legal works. Over the years different authors had carried various types of measurements on dry human sacrum. **Materials and Methods:** The present study carried out on 50 sacra of unknown sex contains 24 male and 26 female sacra identified by physical characteristics. They were collected from Gujarat. Parameters like maximum sacral length and maximum sacral breadth were measured on the sacrum and sacral index calculated by that. **Results:** In present study the mean of sacral length in male is 102.58 mm and in female 111.74 mm. The mean of sacral breadth in male is 103.21 mm and in female 102.34 mm and the sacral index is 99.68 in male and 109.36 in female. This index was compared with similar studies from Gujarat and other parts of India. **Conclusion:** Sacral index and sacral length both are statistically significant. So from sacrum it is possible to identify sex and also help in medicolegal aspects.

**Keywords:** Sacrum; Sacral Index; Maximum sacral length; Maximum sacral breadth.

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### Introduction

The best indicators of sex in the skeleton are to be found in the pelvis. This is because one of the major biological differences between women and men, that of having babies of that part of the body. The sacrum (Latin-sacrum = sacred) is a large flattened triangular /wedge shaped bone formed by the fusion of five sacral vertebrae. Sacrum is an important bone for identification of sex in human skeletal system, because the bones of the body perish after the enamel of teeth after death. For sex determination of human skeletal remains, sacrum always captured the attention

in forensic science experts and anthropologists. Accuracy of sex identification based on the study by Krogman [1] Entire skeleton is 100%, pelvis plus skull is 98%, pelvis alone 95%, skull alone 90% and long bones alone 80%. Most anatomists do not claim 100% accuracy even when skeleton is available. Morphological features over the bones also depend on the geographic, nutritional and occupational factors. Thus, present study aims at determining the significance of sacral index in sex determination and compares the findings with different races according to literature available. The accurate method for identification of female or male type sacrum has often been the sacral index method as explained in the Hrdlicka's practical Anthropometry [2].

*The formula for Sacral Index is:* Maximum width X 100 / Maximum straight length

The sacral index compares sacral breadth (between the most anterior points on the auricular surfaces) with sacral length (between midpoints on the anterior margins of the promontory and apex): average values for males and females are 105% and 115%, respectively [3].

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**Materials and methods**

The study was conducted on 50 dry human sacra procured from Department of Anatomy, GMERS Medical College, Patan and Vadnagar, Gujarat. All the measurements were taken with the help of digital Vernier caliper. All measurements were taken in millimeters. Following parameters were studied: -

*1. Maximum length of sacrum: (anterior straight length-SL)*

It measures the straight distance from sacral promontory in the mid sagittal plane to the middle of the anterior-inferior border of the last sacral segment.

*2. Maximum breadth (width) of sacrum:*

By taking two points at the lateral most part of the ala of sacrum.

*3. Sacral index = maximum breadth X 100/ maximum length*

Mean, standard deviation, range were calculated and data was statistically analyzed.

**Results**

The mean of sacral length in male is 102.58 mm and in female 111.74 mm (Table 1). The mean of sacral breadth does not have much difference between male and female which was 103.21 mm in male and 102.34 mm in female (Table 1). So difference found significant statistically in length but not in breadth. Sacral index is 99.68 in male and 109.36 in female (Table 1). Sacral index in male is lesser than female. This difference found statistically significant.

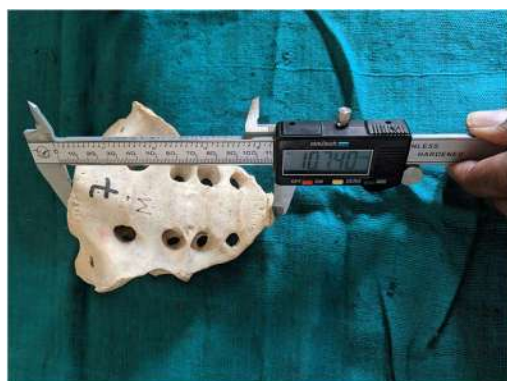
Here I am depicting some important figures. Figure 1 showing how we taken measurement of length of sacrum by digital Vernier caliper and

**Table 1:** Measurements of sacrum in the present study

Sr. no.	Parameter	Sex	Range	Mean	SD
1	Length of sacrum (mm)	Male	98.18 - 106.57	102.58	3.21
		Female	101.87 - 119.73	111.74	7.21
2	Breadth of sacrum (mm)	Male	93.38 - 112.49	103.21	6.94
		Female	93.87 - 110.95	102.34	6.56
3	Sacral Index (%)	Male	92.54 - 106.94	99.68	5.7
		Female	102.84 - 121.80	109.36	7.28

**Table 2:** Comparative study of Sacral Index with previous studies

Sr. no.	Investigator	No	Male Sacrum		Female Sacrum		
			Mean SI	Range	No	Mean SI	Range
1	Present study	24	99.68	92.54 - 106.94	26	109.36	102.84 - 121.80
2	Mishra SR et al.	74	98.21	90 - 108	42	117.84	103 - 131.25
3	Patel MM et al.	32	96.21	90.5 - 108	32	113.25	104.8-131
4	Raju PB et al.	33	100.85	74.72 - 126.9	11	111.39	88.38 - 134.4
5	Poornima J et al.	81	104.08	81 - 136	64	115.72	85 - 146
6	Mamatha H et al.	25	115.92		25	125.2	
7	Rajpura P et al.	50	101.26	81.23 - 109.61	50	116.18	105.32 - 134.79



**Fig. 1:** Measurement of Length of sacrum



**Fig. 2:** Measurement of Breadth of sacrum

Figure 2 showing how we taken measurement of breadth of sacrum by digital Vernier caliper.

### Discussion

Anthropometric characteristics have direct relationship with sex, shape and form of an individual and these factors are intimately linked with each other and are manifestation of the internal structure and tissue components which in turn, are influenced by environmental and genetic factors. Human sacrum is one of the important bone used for identification of gender. In general, the mean of Sacral Index was higher in females than in males.

If we compare the mean value of sacral index in previous studies, mean of male sacral index is higher than P at el. MM et al. [4] and Misra SR et al. [5] but is lesser than Raju PB et al. [6], Poornima J et al. [7], Mamatha Het et al. [8] and Rajapur P. et al. [9]. (Table 2).

Mean of female sacral index is lesser than Misra SR et al. [4], Patel MM et al. [5], Raju PB et at. [6], Poornima J et al. [7], Mamatha H et al. [8] and Rajapur P. et al. [9] (Table 2).

The present study showed that according to sacral index method 79.17% (19 numbers) of male sacra were identified and 65.38% (17 numbers) female sacrum were identified accurately. Patel MM et al. [5]. Showed 62.5% male sacra and 68.75 of female sacra were identified using sacral index method. Rajapur P. et al. [9] all also showed that 84% of male sacra and 70% of female sacra were identified using the sacral index method.

### Conclusion

The present study showed the significant difference in sacral index of male and female. Hence it can be concluded that sacral index is reliable criteria for difference of sex from sacrum and its use.

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