ORIGINAL ARTICLE

SACRAL INDEX IS MORE RELIABLE THAN KIMURA'S BASE WING INDEX FOR SEX DETERMINATION OF A SACRUM

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ABSTRACT

Introduction: sacrum is an important bone for identification of sex of an individual by using skeletal material among anatomist, anthropologist and forensic experts.

Aim: to find out diagnostic efficacy of sacral index and Kimura's base wing index methods of sex determination of sacrum.

Material and method: 100 fully ossified adult sacrum of known sex were used and data were collected by using vernier caliper. Both sacral index and Kimura's base wing index methods of sex determination were applied and analyzed by using Z-test.

Conclusion: The results were compared with the available literatures and it was found that sacral index is more reliable than Kimura's base wing index for establishing sex of a sacrum.

Key words: Sacrum, sex determination, sacral index, Kimura's base wing index

INTRODUCTION

In establishing the personal identity with respect to sex, anatomist and anthropologist use the skeletal material for giving their opinion because the bones of the body are the lasts to perish after death, next to the enamel of teeth. The examination of the bones also helps in the study of archaeological specimen obtained after excavation, as well in medico-legal cases for establishing the personal identity[4].

Sacrum is an important bone for identification of sex in human skeletal system, since it is an important 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 sexes; it has an applied importance in determining sex with the help of measurements carried upon it. In spite of the classical status of human sacrum as regards the identification of sex, and the quantum of work that has been done over the period of history of anthropology by enthusiastic workers, the field is still open for bringing out more elaborate and decisive items that would further refine the judgment in the matter[2].

Over the years different authors had carried various types of measurements on human sacra of different races and regions. But most of the studies on sacrum has been done by foreign scientists in abroad.

A comparison and verification of the finding over a geographical distribution is of prime importance and this zone (Rajasthan) has remained virgin enough of such works . Hence it is an attempt to determine the sex of skeleton by Sacrum in Indian population & establishing the comparative relevance of sacral index & Kimura's Base Wing Index methods for sexing of Sacrum. The present study was carried out in adult subjects and it is hoped that this study would be useful in medico-legal & anthropological cases in future.

MATERIAL & METHOD

The present study was conducted on 100 fully ossified adult sacra of known sex (58 males and 42 females). These sacra were selected after rejecting the bones having any fractures, pathology or wear and tear & incomplete ossification.

The study was conducted in the department of Anatomy, S.M.S. Medical College, Jaipur (Rajasthan) and S.P.Medical College Bikaner (Rajasthan).

All the measurements were taken with the help of a stainless steel sliding vernier caliper.

Method: There were two methods followed. And in both the methods, the use of sliding vernier caliper was incorporated. The first method was to determine the sacral index of sacrum. Therefore sacral index was

measured by taking the breadth and length of individual sacrum with the help of vernier caliper. The stem of caliper was applied to upper surface of the sacrum and measurement of maximum breadth was taken across the greatest expanse of lateral masses of the bone as shown in photograph-1.

Fig 1: Measurement of breadth of sacrum.

Maximum length of sacrum is measured along the mid-line of sacrum with the sliding caliper from middle of antero-superior margin of promontory to middle of antero-inferior margin of the last sacral vertebra as shown in photograph-2.

Fig 2: Measurement of length of sacrum

The second method adopted by the present study for sexing the sacrum was by means of Kimura's method of base-wing index. According to the above method, the transverse width of sacral base, as shown in photo-graph-3(i.e.: the transverse width of superior surface of body of first sacral vertebra i.e.: transverse diameter of body of S1) was measured with the sliding caliper by taking one point on each side of the lateral most point on the superior surface of body of 1st sacral vertebra.

The other parameter the transverse width of the wing (lateral margin of the base to the most lateral border of the wing or ala of sacrum) measured with the sliding caliper by taking distance between lateral margins of body to most lateral border of the Wing as shown in phoptograph-4 was taken into consideration.

Photograph-3 Showing measurement of transverse diameter of body of S1

Photograph -4 Showing measurement of width of Ala or Wing of sacrum.

By using the above measurements, the following indices were calculated:

1. **Sacral index** = Maximum Width x 100 / Straight Length

2. **Kimura's Base Wing Index** = Width of Wing x 100 / Width of Base

(Here width of base is transverse diameter of body of S1 or transverse Diameter of superior surface of body of S1).

OBSERVATIONS

Straight length of the Sacrum, width of Sacrum, trans-verse diameter of body of 1st sacral vertebrae (Base),and transverse width of ala (wing) of 100 Sacrum of known sex (58 males & 42 females) were measured with the

help of vernier caliper. Then sacral index & Kimura's Base Wing Index were calculated.

The data's and results were compiled and arranged in the tables and subjected to statistical analysis.

The differences in the mean values of males and females were analyzed statistically and their significance is shown in table No.3 & 4. By observing the tables it is clear that the width of sacrum is the only parameter, which showed insignificant difference between the males and females.

The observations showed that in case of the sacral index method; the range for males was 85 to 106 and in case of females it was 100 to 126 ; mean for males was 96.25 and for females it was 113.33 ,as shown in table-1. Thus by using (mean±3S.D), the demarking point for males was 96.62 and for females was 112.60 . The present study had found 27 readings of male falling within the demarking point and 24 readings of female falling within demarking point. Therefore, the percentage of sacrum identified by demarking point ,for males was 46.55 and for females was 57.14 as shown in table-1.

Table 1: All the Parameters of Sacral Index

Parameters	Male	Female
Range	85-106	100-126
Mean	96.25	113.33
Sd	5.45	5.57
Mean + 3Sd	79-90 – 112.60	96.62 – 130.04
Demarking point	< 96.62	> 112.60
No. of bone	27	24
Percentage of bone	46.55	57.14

The observations showed that in case of the Kimura's base-wing index method; the range for males was 36 to 87 and in case of females it was 55 to 96 ; mean for males was 61.60 and for females it was 79.40 as shown in table-2.

Table 2: All the parameters of Kimura's Base Wing Index

Parameters	Male	Female
Range	36 – 87	55 – 96
Mean	61.60	79.40
Sd	10.88	11.14
Mean + 3Sd	28.96-94.24	45.98-112.82
Demarking point	< 45.98	> 94.24
Bones identified by DP	6	4
% of bone identified by DP	10.34	9.52

Thus by using (mean±3S.D), the demarking point for males was 45.98 and for females was 94.24. The present study had found 6 readings of male falling within the demarking point and 4 readings of female falling within demarking point. Therefore, the percentage of sacrum identified by demarking point ,for males was 10.34 and for females was 9.52 as shown in table-2.

As per table no.3, the mean length of male bones was 106.96 & for females it was 90.52 It was observed that the mean length of bones was found to be higher in males as compare to females.

The mean difference in length of bones of two sex statistically differ highly significantly i.e. P<0.001

The mean breadth of male bones was 103.07 & for females it was 102.67 It was observed that the mean breadth of bones was found to be higher in females as compare to males. But the mean difference in breadth of bones of two sex statistically do not differ highly significantly i.e. P>0.05

Table 3: Mean +3 SD of parameters

Parameters	Male	Female	P-value
Length	106.96 + 6.88	90.52 + 3.91	< .001
Breadth	103.07 + 9.00	102.67 + 7.41	> .05*

* Non significant

Table -4: Sex wise Mean+ 3SD of parameters

Parameters	Male	Female	P-value
Transverse diameter	50.17 + 3.81	41.88 + 2.86	< .001*
Ala	30.84 + 6.31	33.26 + 5.04	< .05

*Highly significant

Table 1 and 3 shows that the length of sacrum and sacral index are important parameters as far as the sex determination of sacrum is concerned because 46.55 % of male bones and 57.14% of female bones could be identified by using the DP for the above parameters.

The mean value of transverse diameter of Body of 1st Sacral vertebra of male bones was 50.17 & for females it was 41.88. It was observed that the mean value of transverse diameter of Body of 1st Sacral vertebra of male bones was found to be higher in males as compare to females.

The mean difference in value of transverse diameter of Body of 1st Sacral vertebra of bones of two sex statistically differ highly significantly i.e. P<0.001

The mean width of Ala of male bones was 30.84 & for females it was 33.26 It was observed that the mean width of Ala of Sacrum was found to be higher in females as compare to males.

The mean difference in Width of Ala of Sacrum of two sex statistically differ significantly i.e. P<0.05.

DISCUSSION

Arora et al (2008)[2] has done research on Significance of Sacral Index in estimation of Sex in Sacra of Cadavers in Punjab .They found out that in the identification of sex in human skeletal remains. A study for sexing of sacra was carried on 40 sacra (20 male & 20 female sacra) in Punjab. They used sacral index method. The sacral index of sacra its mean and standard deviations were calculated. Then they calculated range (mean + 3S.D.) and demarking points (DP) of both the parame-

ters and the percentage of bones in which sex could be identified by them. The results were compared with the available literature. It was found that D.P of sacral index was very reliable in sexing of sacra.

Patel et al (2005)[1] showed that according to sacral index method; 62.5% of male sacra were identified (demarking point) and 68.75%of female sacra (demarking point) were identified. Thus 20 readings out of 32 males sacra confirmed male type and 22 reading out of 32 female sacra confirmed female type by using Sacral index method. Their study also showed that according to Kimura's Base/Wing index method only 18.75% (demarking point) of male and female sacra were identified. Thus, only 6 readings out of 32 male sacra confirmed male type and 6 readings out of 32 female sacra confirmed female type while using Kimura's Base Wing index method. Similarly my study showed that according to sacral index method; 46.55% of male sacra were identified and 56.44% of female sacra were identified. Thus 27 readings out of 58 male sacra confirmed male type and

24 reading out of 42 female sacra confirmed female type by using Sacral index method. In my study also the females are classified with more accuracy than males. In my study by using Kimura's Base Wing index method only 10.34% of male and 9.52% female sacra were identified. Thus, only 6 readings out of 58 male sacra confirmed male type and 4 readings out of 42 female sacra confirmed female type while using Kimura's Base Wing index method.

In study of patel et al percentage of male and females identified by using Kimura's Base Wing index method were equal (18.75%) but, In my study the accuracy for males is slightly more than that of females.

Arora et al (2008)[2] study showed that according to sacral index method; 45% of male sacra were identified (demarking point) and 40% of female sacra (demarking point) were identified. Thus 9 readings out of 20 males sacra confirmed male type and 8 reading out of 20 female sacra confirmed female type by using Sacral index method. In this study also the females are classified with more accuracy than males as in my study.

CONCLUSION

Whenever an opinion will be given by anatomist and anthropologist by using skeletal material to establish the personal identity with respect to sex, the diagnostic efficacy of sacral index is higher than Kimura's base wing index for sex determination of sacrum

BIBLIOGRAPHY

1. M.M.Patel, B.D. Gupta, T.C. Singel ;Sexing of Sacrum by Sacral Index and Kimura's Base Wing Index method,JIAFM/2005; 27(1). ISSN 0971-0973
2. Amarpreet kaur Arora, Pankaj Gupta, Shashi Mahajan, Sonney Singh Kapoor. Significance of Sacral Index in Estimation of Sex in Sacra of Cadavers in Punjab . Journal of Indian academy of Forensic medicine,2008, ISSN 0971-0973; *32(2)* 104
3. Mishra S R, Singh P J, Agrawal A K, Gupta R N. Identification of sex of sacrum of Agra region, J. Anat. Soc. Ind. 2003; 52 (2): p7-12.
4. Deshmukh AH and Devershi DB, Comparison of cranial sex by univariate and multivariate analysis, J Anat Soc. India,2006, 55(2), p48-51
5. Raju P B, Singh S. Padamnabhan R.; Sex determination and sacrum. Journal of Anatomical Society of India 1981; 30: p13-15
6. Kimura K. A base-wing index for sexing the sacrum, J Anthrop Soc. Nippon, 90 suppl 1982; p153-162.
7. Charnalia, V.M. Sex difference and determination in human sacra in South India. J.Ant. Soc. Ind. 1967:16: (1): 33.
8. Benazzi, Stefano; Maestri, Claudia; Parisini, Simona Sex Assessment from the Sacral Base by Means of Image Processing. Journal of Forensic Sciences, Volume 54, Number 2, March 2009 , pp. 249-254(6)
9. Flander L B. Univariate and multivariate methods for sexing the sacrum. Am. J. Phys. Anthrop. 1978; 49: 103-110.