International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

ISSN:2347-6567

IJAMSCR |Volume 4 | Issue 4 | Oct - Dec - 2016
www.ijamscr.com

Research article *Medical research*

Sex Determination by Osteometric Analysis of Sternal End of Fourth Rib in Haryanvi Population

Jai Prakash Soni*, S.K. Dhattarwal, Suresh Kantha Rathee*****

[1]*Ex. Resident, Department of Forensic Medicine, PGIMS Rohtak Haryana, India.*
[2]*Head, Department of Forensic Medicine, PGIMS Rohtak Haryana, India.*
[3]*Head, Department of Anatomy, PGIMS Rohtak Haryana, India.*

***Corresponding Author**: **Dr. Jai Prakash Soni**
Email id: **dr.jaiprakashsoni@gmail.com**

ABSTRACT

Background

Sex is a very important identification point, since mainly there are two sexes: Male or Female. Generally, skull and pelvic bones are dimorphic but when these bones are not available ribs can act as a dimorphic bone to predict sex.

Aim and Objectives

Sex Determination by Osteometric Analysis of Sternal End of Fourth Rib in Haryanvi Population.

Material and Method

The specimen consisting of fourth ribs were collected from 50 males and 50 females during the year 2014 to 2015 at the Forensic department of Pt. B. D. Sharma Postgraduate Institute of Medical Sciences Rohtak Haryana, India. The samples were divided into young and old age group. Superior–inferior height (SIH), anterior–posterior width (APW) and pit depth (PD) of the sternal end of fourth rib were taken.

Results

The correct sex determination in younger and older age group was 84.65% and 81.75% respectively.

Conclusion

The result demonstrated that SIH and APW were highly dimorphic in all group while PD was dimorphic in older age.

INTRODUCTION

Identification is very important in solving crimes and in mass disaster. Sex is a most important factor for identification. When the body was fresh during post-mortem examination, it is very easy to identify sex by external genitalia but when body was decomposed or skeletonized its difficult. Krogman comments that he scored 100 per cent accuracy using the whole skeleton, 95 % on pelvis, 92 % on skull, 98 % on pelvis plus skull, 80 % on long bones and 98 % on long bones plus pelvis.[1] Sex can be estimated reasonably well using long bone measurements or visual estimations.[2] Long bones have been found to be highly dimorphic, especially in areas such as the head and distal epiphysis of the femur, and proximal epiphysis of the tibia.[3] Forensic expert and anthropologists have turned their interest to obtain more information from fragmentary as well

as smaller bones.[4] With this in mind, many apparently less sexually dimorphic fragmentary small bones have been analyzed to determine sex. These bones include the clavicle[5], sternum[6,7], radius[8,9], metacarpals and phalanges[10-13], metatarsals[14], vertebrae[15] and pelvis.[16-18] One possible area that may aid in the estimation of sex is the sternal end of the fourth rib.

In the absence of the pelvis and long bones, the fourth rib was chosen in most of the previous studies pertaining to ribs because the fourth rib was easily obtained during routine postmortem examinations and it made for easier comparison to later studies like Iscan[19] & others who had worked on sex determination from sternal end of fourth rib.

AIMS & OBJECTIVES

1. To study the sexual dimorphism in the sternal end of fourth rib by osteometric analysis.
2. To find out the best parameter to be used for sex determination by measurement of sternal end of fourth rib.

MATERIAL AND METHOD

The present study was undertaken in the Department of Forensic Medicine, Pandit Bhagwat Dayal Sharma, Post Graduate Institute of Medical Sciences, Rohtak. 100 pairs of fourth ribs were taken from dead bodies (50 Male and 50 Female) brought for postmortem examination in mortuary. The material was comprised of fourth ribs collected at autopsy both from right and left side of dead body, of known age and sex. The sternal end of fourth rib was collected after identifying and by cutting two inches long portion along with costochondral junction with the help of rib cutter. To avoid mixing of each rib, it was suitably tagged.

The specimens were left in glass container filled with saturated solution of sodium chloride for 6 to 8 weeks. So that the soft tissues which adhere to the ribs macerates and then cleaned these ribs, after that dried for 2 to 3 days. Three osteometric measurements were taken at the sternal end of fourth rib with the help of digital vernier caliper to the nearest tenth of a millimeter:

1. Maximum Superior Inferior Height (SIH)- Distance between upper most and lower most point at sternal end of fourth rib.
2. Maximum Anterior Posterior Width (APW)- Distance between anterior most and posterior most point at sternal end of fourth rib.
3. Maximum Pit Depth (PD)- Distance between deeper most part of pit to the outer most part of sternal end of fourth rib.

To develop sex determination functions and to control the effect of age, the sample was separated into three groups:

1. young group (15–32 years);
2. old group (33–89 years); and
3. Total group (15–89 years).

All the above measurements were subjected for statistical analysis for achieving our aims and objectives.

Statistical Analysis

The Statistical Product and Service Solutions (SPSS version 20) program was used to analyze all the data. Descriptive statistics, which include mean and standard deviations, were obtained for all measurements. After establishing, that a significant difference exists between male and female mean values for each of the measurements using the F-statistic, the data were subjected to discriminant function analysis. Standard canonical discriminant function co-efficient were obtained and discriminant function were calculated. Structure matrix value was obtained and the value having more positive value indicates the best parameter for the study. Then all the data were compiled by SPSS to find out the correctness of the classification, sensitivity and specificity for the differentiation of gender.

Result

Table 1: **Means, standard deviations, t-test and p-value.**

Age groups	Variables	Male		Female		t-test	p-value
	N=100	50		50			
Total group		Mean	S.D.	Mean	S.D.		
	Age	33.06	14.61	30.68	13.35	0.850	0.397#
	SIH	15.75	2.11	12.79	1.22	8.558	0.000*

	APW	7.16	1.17	5.82	0.78	6.770	0.000*
	PD	2.55	1.34	1.76	0.68	3.717	0.000*
Young group	**N=68**	**31**		**37**			
	Age	23.16	4.04	24.19	4.57	-0.973	0.334#
	SIH	14.63	1.64	12.53	1.01	6.481	0.000*
	APW	6.52	0.76	5.65	0.61	5.227	0.000*
	PD	1.88	0.86	1.73	0.68	0.802	0.426#
Old group	**N=32**	**19**		**13**			
	Age	49.21	10.46	49.15	12.88	0.014	0.989#
	SIH	17.58	1.41	13.56	1.49	7.728	0.000*
	APW	8.20	0.94	6.30	1.00	5.463	0.000*
	PD	3.66	1.25	1.87	0.71	4.659	0.000*

Note: All dimensions except age are in millimeters.

* Very Highly Significant difference.

Non-Significant difference

Table 2: Stepwise discriminant function analysis for young, old and total Samples

Variable	**Wilks' Lambda**	**Equivalent F ratio***
Young group		
1. SIH	0.611	41.998
2. APW	0.707	27.316
3. PD	0.990	0.643
Old group		
1. SIH	0.334	59.728
2. APW	0.501	29..843
3. PD	0.580	21.705
Total group		
1. SIH	0.572	73.234
2. APW	0.681	45.837
3. PD	0.876	13.818

*F ratio shows that differences between the sexes.

Table 3: Canonical discriminant function coefficients

Function and variables	**Standardized canonical discriminant function coefficients**	**Canonical discriminant function coefficients***	**Structure matrix**	**Centroids[a]**
		Young group		
SIH	0.765	0.574	0.766	1.121[a]
APW	0.778	1.135	0.618	-0.939[a]
PD	-0.703	-0.915	0.095	
		Constant		
		-12.962		
		Old group		
SIH	0.788	0.545	0.907	1.246[a]
APW	0.362	0.375	0.641	-1.821[a]
PD	0.097	0.091	0.547	
		Constant		
		-11.737		
		Total group		
SIH	0.836	0.484	0.890	0.961[a]
APW	0.714	0.721	0.704	-0.961[a]
PD	-0.640	-0.602	0.387	
		Constant		
		-10.291		

*These coefficients are used to calculate discriminant scores. Discriminant score formula were [**SIH*0.484 + 0.721*APW – 0.602* PD – 10.291**] for total group, [**0.574* SIH + 1.135*APW – PD*0.915-12.962**] for the young group and [**0.545* SIH + 0.375*APW – 0.091*PD - 11.737]** for the old group.
[a] Positive centroids define male and negative for female.

Table 4: The percentage of correct prediction of three age based functions.

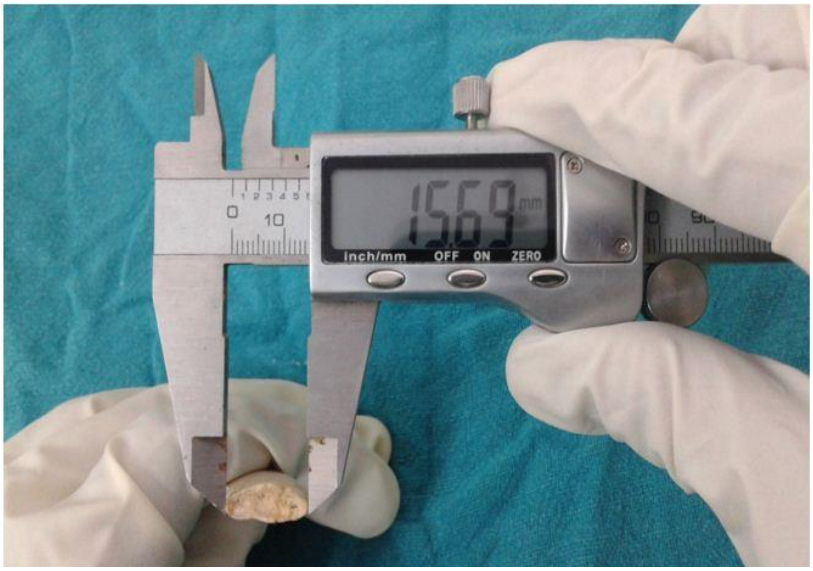
Function and variables	Total	Male		Female		Averages
	N	N	%	N	%	%
Young group	68	31	77.4	37	91.9	84.65
Old group	32	19	78.9	13	84.6	81.75
Total group	100	50	78.0	50	90.0	84.0

Table 5: Outcome of Receiver Operator Curve analysis for sternal end of fourth rib parameters in prediction of male gender:-

Cut-off values ≥

SN	Parameter	AUC*	Projected cut-off value	Projected Sensitivity (%)	Projected Specificity (%)
1	**SIH**	0.888	13.64	80	86
2	**APW**	0.837	6.53	70	84
3	**PD**	0.693	2.79	42	92

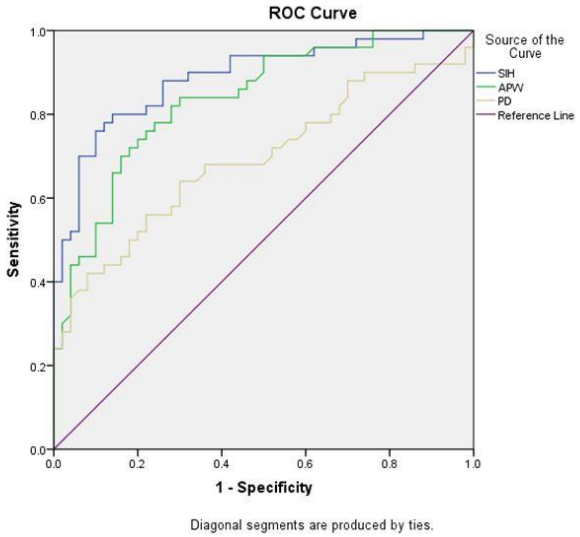
*AUC= Area Under Curve



Legend of figure 1: Superior Inferior Height (SIH)

Legend of figure 2: Anterior Posterior Width (APW)

Legend of figure 3: Pit Depth (PD)



Legend of figure 4: ROC Analysis showing AUC for different sternal end of fourth rib parameters in prediction of male gender.

RESULT

The age distribution, descriptive statistics and a test of significance between sexes (univariate F ratio) are shown in Table 1. Stepwise discriminant function analysis is given in Table 2. Stepwise discriminant function analysis showed that sex determination was possible in 77.4% for males in the young group and 91.9% for females of the young group and 84.65% in total. The most effective parameter to determine sex was SIH, APW can be used secondly, especially in the young group. Canonical discriminant function coefficients are shown at Table 3. The percentages of correct prediction of three age-based functions are shown in Table 4. In the older age group, SIH, APW and PD are found to be effective sex parameters. The accuracy rate in this group was 78.9% for males, 84.6% for females and 81.75% in total. As in the young group, the statistical analysis of all cases showed that SIH was the most important parameter to determine sex. APW could be used next and PD comes last especially in the old group but PD is not significant in younger age group. Determination of sex was possible in 78.0% of males, 90.0% of females and 84.0% for all as shown in Table 4. Discriminant formulae were [**SIH*0.484 + 0.721*APW – 0.602* PD – 10.291**] for total group, [**0.574* SIH + 1.135*APW – PD*0.915-12.962**] for the young group and [**0.545* SIH + 0.375*APW – 0.091*PD - 11.737]** for the old group as shown in Table 3. For sternal end of fourth rib, SIH had the maximum AUC (0.888), thus indicating that it is best parameter for differentiation between males and females. The projected sensitivity of SIH was 80% and projected specificity was 86% followed by APW having AUC of 0.837 with projected sensitivity of 70% and specificity of 84%. PD had the minimum AUC (0.693) as shown in Table 5 and figure no. 4.

DISCUSSION

Iscan et al. [19,20] discovered that the adult rib can be reliably used to determine sex by discriminant function analysis. It is also known that rib size depends on both age and population. So formula developed for one population to determine sex cannot be applied to another population; it must be modified. In this study we found SIH and APW parameters useful for sex determination similar to another Turkish study in Istanbul [20]. However, PD results were found to be effective for the results in older and total age group but not effective in younger age group. Although the most effective parameters are the same in both studies. In our study sex determination formulae were found to be more effective for females, and less effective for males. This study indicates that sexual dimorphism can be assessed by using a fourth rib in an Indian population from ages 15 to 70. SIH of the rib is the most reliable parameter followed by APW.

BIBLIOGRAPHY

[1]. Krogman WM, Isacn MY. The Human Skeleton in Forensic Medicine. Illinosis : Charles C Thomas. 2, 1986, 228.
[2]. Rissech C, Schaefer M, and Malgosa A. Development of the femur implications for age and sex determination. Forensic Sci Int. 180(1), 2008, 1-9.
[3]. Iscan MY, and Miller-Shaivitz P. Discriminant function sexing of the tibia. J Forensic Sci. 29(4), 1984, 1087-93.
[4]. Krogman WM, Iscan MY. The human skeleton in forensic medicine. Charles C Thomas Publisher, Springfield. 32, 1987, 452–66.
[5]. Jit I, Singh S. The sexing of adult clavicles. Indian J Med Res. 54, 1966, 551–71.
[6]. Coltu A, Dura D, Savci G. Cinsiyet tayininde sternum olculerinin degeri. Adli Tip Derg. 8, 1992, 49–53.
[7]. Jit I, Jhingan V, Kulkarni M. Sexing the human sternum. Am J Phys Anthropol. 53, 1980, 217–24.
[8]. Singh SG, Singh SP, Singh S. Identification of sex from the radius. J Indian Acad Forensic Sci. 13, 1974, 10–6.
[9]. Hanihara K. Sexing diagnosis of Japanese long bones by means of discriminant function. J Anthropol Soc Nippon. 66, 1958, 187–96.

[10]. Lazenby RA. Identification of sex from metacarpals: Effect of side asymmetry. J Forensic Sci. 3(5), 1994, 1188–94.
[11]. Scheuer JL, Elkington M. Sex determination from metacarpals and the first proximal phalanx. J Forensic Sci. 38(4), 1993, 769–78.
[12]. Falsetti AB. Sex assessment from metacarpals of the human hand. J Forensic Sci. 40(5), 1995, 774–6.
[13]. Smith SL. Attribution of hand bones to sex and population groups. J Forensic Sci. 41(3), 1996, 469–77.
[14]. Smith SL Attribution of foot bones to sex and population groups. J Forensic Sci.42(2), 1997, 186–95.
[15]. Marino EA. Sex estimation using the first cervical vertebra. Am J Phys Anthropol. 97(2), 1995, 127–33.
[16]. Iscan MY, Derrick K. Determination of sex from the sacroiliac joint: A visual assessment technique. Am J Phys Anthropol. 64, 1984, 53–7.
[17]. Sundick RI Age and sex determination of sub adult skeletons. J Forensic Sci. 22(1), 1977, 141–4.
[18]. Huggare J. Population differences in the morphology of the first cervical vertebrae. Am J Phys Anthropol. 88(2), 1992, 197–201.
[19]. Iscan MY. Osteometric analysis of sexual dimorphism in the sternal end of the rib. J Forensic Sci. 30(4), 1985, 1090-9.
[20]. Cologlu SA, Iscan MY, Yavuz MF, Sari H. Sex determination from the ribs of contemporary Turks. J Forensic Sci. 43(2), 1998, 273–6.

How to cite this article: Jai Prakash Soni, S.K. Dhattarwal, Suresh Kantha Rathee. Sex Determination by Osteometric Analysis of Sternal End of Fourth Rib in Haryanvi Population. Int J of Allied Med Sci and Clin Res 2016; 4(4): 668-674.
Source of Support: Nil. **Conflict of Interest:** None declared.