# Reliability of Criteria used for Sexing of Hip Bones.

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**Abstract:** For demarking a male from a female hip bone, the reliability of three most commonly used parameters i.e. chilotic line index, ischio-pubic index and acetabulo-pubic index were checked on 205 hip bones (143 males & 62 females). For all the three parameters " demarking points" were worked out. None of the parameters were promising in indentifying sex as a very low percentage of bones could be identified. The study concluded that the reliability of all the above parameters is doubtful.

**Key words:** Demarking points, hip bone, sex determination, chilotic line index, ischio-pubic index, acetabulo-pubic index.

## Introduction :

The identification of sex from skeletal remains is of great medicolegal and anthropological importance. Hip bone is an ideal bone for sex dertemination because it not only reflects the general differences between the two sexes but also the special adaptation of female hip bone for child bearing. In the past, many workers have evolved various metrical parameters and indices for sexing of hip bone, Derry (1923), Sraus (1927), Washburn (1949), Davivong (1963), Jovanovic and Zivanovic (1965), Jovanovic et al (1968), Singh and Potturi (1978), Schulter Ellis (1983), Turner (1986), Pal, Bose and Choudhary (2004).

Following three parameters are commonly used in sexing the hip bones and are considered to be the most reliable i.e. chilotic line index, Derry (1923), Ischio-pubic index, Washburn (1949) and Acetabulo - pubic index, Schulter Ellis (1983). It has been claimed that these parameters could determine the sex in a high percentage of bones.

Mewalal (1993) evaluated the reliability of many commonly used parameters, including the above three, on large number of hip bones. He found that most of these parameters when subjected to vigorous stastical analysis, were not effective. This prompted us to check the reliability of the above mentioned parameters.

## Material & Methods :

Material of the study consisted of 143 male (72 of right and 71 of left side) and 62 female (32 right & 30 of left side) hip bones. All the bones were fully ossified (adult) bones and free from any pathological or congenital defect. These bones were obtained from various sources i.e. Medicolegal Institute, Government of Madhya Pradesh, Bhopal; Department of Forensic Medicine, Gandhi Medical College, Bhopal, Rukmanibai Gardi Medical College, Ujjain and Modern Dental College & Research Centre, Indore.

Following three parameters were used for measurements :

- Chilotic line index (Derry, 1923)

$$\frac{\text{Sacral part of chilotic line}}{\text{Pelvic part of chilotic line}} \times 100$$

- Ischio-pubic index (Washburn, 1949)

$$\frac{\text{Length of pubic bone}}{\text{Length of Ischial bone}} \times 100$$

- Acetabulo - pubic index (Schulter Ellis,1983)

$$\frac{\text{Acetabular diameter}}{\text{Pubo - Acetabulum Length}} \times 100$$

Measurements for all the above indices were taken as per the method described by authors.

The data obtained for all these parameters were analysed stastistically to find range, mean and standard deviation (S.D.) in both the sexes. The student 't' test was applied to know whether these differences of means between two sexes were stastically significant or not. These parameters were then subjected to "demarking points" (DPs) analysis as evolved by Jit and Singh (1966).

## Results :

As no stastically significant difference was observed between right and left sides in both sexes for various linear measurements, the data for two sides were pooled.

The range, mean, standard deviation (S.D.) and identification points (I.Ps) for various indices in two sexes are presented in Table - I. For all the three parameters, 't' values indicated stastically significant differences between mean values of males and females. Male values were always higher than females. This table also shows the identification point (I.P) and % of bone identified with the help of I.P. With the help of this method the parameter ischio-pubic index could identify only 35.6% males and 24% female hip bones.

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58

**Table-I**

Range, Mean,S.D. & I.P. of various indices in two sexes

(M = 143, F= 62)

| | | Chilotic line index | Acetabulo-Pubic index | Ischio-pubic index |
|---|---|---|---|---|
| Male | Range | 79-137 | 69.4-98.4 | 86.4-114 |
| | Mean | 109 | 84 | 100 |
| | S.D. | 11.17 | 6.79 | 5.01 |
| | I.P. | > 118 | > 87.9 | > 101 |
| | % identified | 25.17% | 30.76% | 35.66% |
| Female | Range | 58-118 | 66-87.9 | 78.7-101 |
| | Mean | 89 | 74 | 89 |
| | S.D. | 12.628 | 5.65 | 4.38 |
| | I.P. | < 79 | < 69.4 | < 86.4 |
| | % identified | 22.58% | 20.96% | 24.19% |
| | t value male/female | 10.78 | 10.92 | 15.80 |
| | P value | P<0.001 | P<0.001 | P<0.001 |

Table-II shows the D.Ps. (Mean ± 3 S.D.) for various parameters. None of these parameters were found to be effective as number of bones identified by these parameters were very few.

**Table-II**

Demarking points for various indices

| No. | Index | Sex | Mean ± S.D. | Cal.range | D.Ps | %Beyond DP |
|---|---|---|---|---|---|---|
| 1. | Chilotic line index | M | 109±11.17 | 75.49-142.51 | >126.88 | 9.09% |
| | | F | 89±12.62 | 51.11-126.88 | <75.49 | 11.29% |
| 2. | Acetabulo-pubic index | M | 84±6.79 | 63.63-104.37 | >90.95 | 12.58% |
| | | F | 74±5.6 | 57.05-90.95 | <63.63 | 0% |
| 3. | Ischio pubic index | M | 100±5.01 | 84.97-115.03 | >102.14 | 27.27% |
| | | F | 89±4.38 | 75.85-102.14 | <84.97 | 17.7% |

## Discussion :

Three common parameters used by Derry (1923, chilotic line index), Washburn (1949, ischio-pubic index) and Schulter Ellis (1983, acetabulo-pubic index);claimed to identify sex in high percentage of hip bones. Using chilotic line index Derry sexed 40% of hip bones. While Washburn (1949) claimed 84% male and 100% female American skeletons could be identified by using the ischio-pubic index. Schulter Ellis (1983) could determine sex in 97% of cases in both American, Whites and Blacks by using acetabulo-pubic index.

However, the findings of Mewalal (1993) and that of present study have indicated that the most commonly used indices (chilotic line, ischio-pubic and acetabulo pubic) were of little value when subjected to " demarking points" analysis.

According to Mewalal (1993) when demarking points analysis was applied, acetabulo-pubic index could identify only 8.3% male & 2.5% of female hip bones; chilotic line index could identify only 53% of male and 2.5% of female hip bones and ischio-pubic index could identify 57% males and 53% female bones.

In the present study percentage of bones identified by above three parameters was still lower (Table -II) as compared to percentage of bones identified by Mewalal (1993).

On finding the cause of this discrepancy (besides racial variations), it was revealed that these authors Derry (1923), Washburn (1949) and Schulter Ellis (1983) used Limiting points, based on overlapping range of their own samples and did not subject their data to more vigoruous stastical analysis, Singh and Potturi (1978). These Limiting points are good only for that particular sample and may not give correct identification of sex when applied to some other unknown bones of same area, population or race.This is due to the fact that biological variables may show wide variations, which the limiting points may not cover even if sample size is large. This problem may easily be overcome by subtracting and adding the three S.Ds. to the mean value (± 3 S.D.). The mean ± 3 S.D. will give the range that covers 99.75% of population of that area, Rao (1962). The range thus obtained is calculated range and the limiting points determined on the basis of this range are the " demarking ponts", Jit & Singh (1966).

As most of the previous workers have used limiting points based on overlapping range of their samples and not subjected their data to demarking point analysis hence, they could claim to identify a large % of bones. Though the bones which could be identified by D.Ps. are mostly few in number but, identification of bone with 100% accuracy is needed in medicolegal cases.

The D.Ps are simple to work out as compared to multivariate analysis. An additional advantage of this method is that it is not necessary that all the parameters of a bone should cross the D.Ps before sex can be assigned. Even if a single parameter crosses the D.P. it would identify the sex of unknown bone with 100% accuracy. It has been worked out by Singh and Gagrade (1968) that it is necessary to determine the D.Ps separately for each race and even for different regions of a same population.

This study concludes and supports the findings of Mewalal (1993) that the three most commonly used parameters (chilotic line index, ischio-pubic index and acetabulo-pubic index) are not reliable and hence, should not be used.

## Acknowledgement :

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