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Sexual dimorphism of acetabulum–pubis index in South-Indian population ☆

K.R. Nagesh [a,*], Tanuj Kanchan [a], Binay K. Bastia [b]

[a] *Department of Forensic Medicine, Kasturba Medical College, Mangalore 575001, Karnataka, India*
[b] *Department of Forensic Medicine, SDM College of Medical Sciences, Dharwad, Karnataka, India*

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Abstract

Accurate sexing of skeletal remains is a vital part of any medicolegal investigation and a challenge to physical anthropologists. Hipbone is considered as the most reliable sex indicator in the human skeleton. Standards of morphological and morphometric sex differences in the skeleton may differ with the population sample involved and thus cannot be applied universally. The acetabulum–pubis index (A–P index) which is one of the reliable criteria for sex differentiation of human hipbones is derived from the measurements of acetabulum diameter and the distance between its anterior rim and symphysis pubis. Sixty-seven adult hipbones of known sex (36 males and 31 females) belonging to South-Indian population were studied to investigate sexual dimorphism of the well established A–P index. The index below 77.5 identified 81% of females and above 77.5 identified 83% males accurately.
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1. Introduction

Sexing the bone plays an important role in any medicolegal investigation, when skeletal remains are recovered. Hipbone (os coxae), considered as an ideal bone for sex determination, provides the highest accuracy levels for sex determination. It not only reflects the general differences between the two sexes but also the special adaptation of female hipbone for child bearing. Based on morphology and morphometry, accuracy of sex determination from adult pelvis alone is 95% [1].

For sexing an adult hipbone, we frequently rely on visual features. This ''Inspectional'' method of sex determination is based on morphological traits like pre-auricular sulcus, shape of the greater sciatic notch, obturator foramen, sub-pubic angle, and size, shape and position of acetabulum and pubis [1,2]. Reliance on the visual assessment of morphology has the disadvantage of introducing a subjective element into sex determination and hence the need to evolve new visual scoring methods [3,4]. Sexing a bone metrically appears more scientific and avoids observational bias.

In the adult hip bone, pubis length and sciatic notch width are generally considered to offer better prospects for reliable sex identification. Although the indices and angles of greater sciatic notch are known to be sexually dimorphic, the most efficient morphological discriminators of sex in human hipbone relate to the pubic bone [5]. Various indices have been derived for human innominate bones that are known to be highly sexually dimorphic. Sciatic notch index, ischio-pubic index and modified ischio-pubic index have been used traditionally with a fair degree of success [1,6,7]. The acetabulum–pubis index (A–P index) is a variant of modified ischio-pubic index that determines sex with an accuracy of over 90%. Earlier studies done on Whites, Blacks, American Indians and Eskimos found A–P index to be more useful than other indices like ischio-pubic index and sciatic notch index in sexing a pelvis [8–10].

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* Corresponding author. Tel.: +91 824 2422271x5565; fax: +91 824 2428183.
E-mail address: drnag2002@rediffmail.com (K.R. Nagesh).

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Standards of morphological and morphometric sex differences in the skeleton may differ with the population sample involved. This is especially true with reference to dimensions and indices and thus cannot be applied universally [1]. In addition, a population variation in the extent of sexual dimorphism has been observed in the human hip bone [11]. As a rule, standards should be used with reference to the group from which they were drawn and upon which they are based [1].

A continuous need to develop and test the indices in different population groups is emphasized since long [12]. The fact that A–P index is suggested as the most efficient sex discriminator in different population groups [8–10] prompted us to evaluate the usefulness of A–P index in discriminating sex of the South-Indian population. To the best of our knowledge, this is the first study that tries to classify male and female hipbones based on A–P index in South-Indian population. Medline search using search items "identification; sex determination; acetabulum–pubis index" did not reveal any result in the specified area for South-Indian population. The present research also attempts to test the reliability of the A–P index among South-Indian population by "Identification point" (IP) and "Demarking point" (DP) analysis.

2. Material and methods

The present study was conducted in the Office of the State Medico-legal Consultant, Kasturba Medical College, Mangalore, India, using the bones that were sent for expert medical opinion. Sex was determined by morphological examination of hipbones as described in Krogman and Iscan [1]. Only the well-preserved, dry, completely ossified adult hipbones, where the identity of victims was confirmed later by the investigating agencies, were included in the study.

The study sample consisted of 36 male and 31 female hipbones of South-Indian origin. One side of each hipbone was considered, since in some cases both hipbones were not sent for examination. When hipbones of both sides were brought for examination, no difference in measurements was observed between the two sides, similar to other studies where no significant pelvic asymmetry is reported between the sides [13,14]. Hipbones with obvious pathological or congenital defect, or skeletal injuries were excluded from the study.

Two measurements (Fig. 1) were recorded for each bone as described by Schulter-Ellis et al. [8].

(i) Pubis length (PS-A): Distance between the superior most point of the pubic symphysis to the nearest rim of the acetabulum in the long axis of pubis.
(ii) Acetabulum diameter (AD): Maximum diameter of acetabulum parallel to the above measurement.

The measurements were recorded by a single author on two different occasions, using a slide caliper. No significant variations were found between both measurements that were measured up to nearest mm. To find out the intra-observer variation, an intra-class correlation coefficient was calculated, which showed 0.9543–0.9825 for acetabular diameter, and 0.9956–0.9983 for pubis length at 95% confidence interval. Acetabulum–pubis index (A–P index) was derived for each bone by using the formula: A–P index $= (AD/PS\text{-}A) \times 100$.

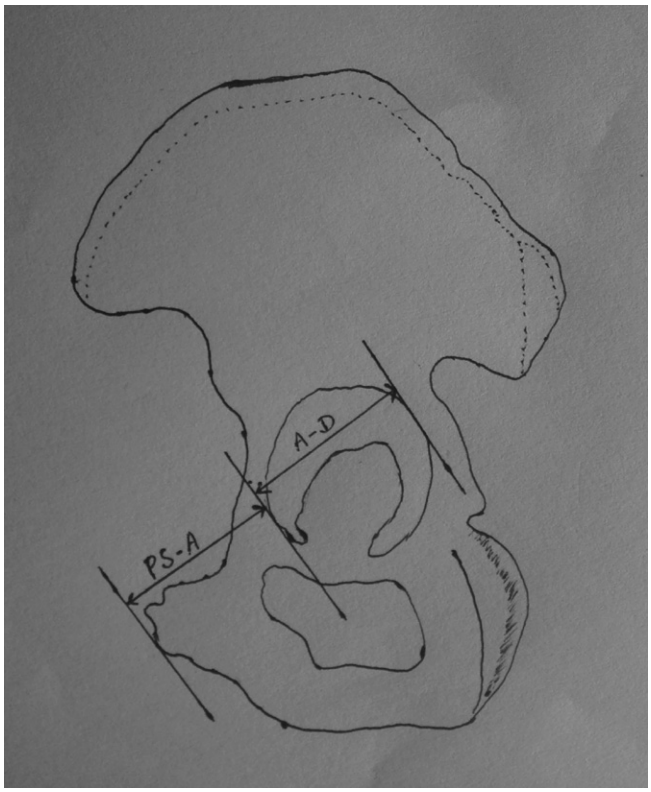

Fig. 1. Hip bone illustrating the measurements – pubis length (PS-A) and acetabulum diameter (AD).

3. Statistical analysis

The data obtained was analyzed statistically using SPSS (Statistical Programme for Social Sciences, version 10.0) computer software. *t*-Test was performed to test the significance, and *p*-value $\leqslant 0.05$ was considered as significant. Average of mean A–P index values of both genders was taken as cut-off point for sex determination of the sample, and termed as "Sectioning point" [5].

To assess the reliability of sex differentiation based on A–P index, data was further subjected to "Identification point" (IP) and "Demarking point" (DP) analysis as evolved by Jit and Singh [15,16]. "Identification point" is derived based on the overlapping range of the sample, while "Demarking point" is derived based on the range obtained by adding and subtracting three standard deviations to the mean value (mean $\pm$ 3 SD).

4. Results

In all the hipbones that were examined, pubis length was greater than acetabulum diameter in both sexes. The

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