A Newly Developed Visual Method of Sexing the Os Pubis[1]

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ABSTRACT Preliminary investigation has indicated that the use of the ventral arc, subpubic concavity, and medial aspect of the ischio-pubic ramus as sexing criteria allows one to sex the os pubis with an accuracy in excess of 95%. The method described here is simple and objective enough to allow the beginning researcher to sex hip bones accurately while requiring the presence of only a small fragment of the bone.

Those of us who often deal with undocumented skeletal material, whether it be in the realm of legal medicine or routine laboratory work with prehistoric osteological collections, find it necessary to use various criteria of skeletal morphology to estimate the sex of the individual(s) under study. It has long been known that the innominates provide the most reliable criteria for the estimation of sex. The methods which are currently at the disposal of the researcher fall into two broad categories. One is the category of visual criteria. These are based on the observations of the morphology of the hip bone which take into account the relative, and to a certain extent intergrading differences between males, and females with reference to such structures as the greater sciatic notch, the width of the pubis, the pre-auricular sulcus and others. These criteria are well known to most investigators and are outlined in such works as Brothwell ('63), Gray ('66), Hrdlicka ('52), Krogman ('62), Montagu ('60), Stewart ('54), and numerous others. There is no need to go into these in great detail here.

Let it only be said that these criteria can be highly accurate in the hands of researchers with many years of experience, but the fact remains that for the researcher with less experience, these criteria often appear ambiguous. There is no indication as to which of the criteria should be more heavily weighted when one is trying to arrive at a sex estimate where the different criteria show varying degrees of maleness and femaleness on the same bone. The use of these criteria, by their relative nature, becomes subjective when the researcher deals with those bones which appear to be intermediate in morphology with respect to sex. One often finds himself wishing that there were some criterion, or criteria which would indicate sex in an absolute rather than relative way — that there were something which would indicate sex by the fact that it is, or is not, present on the bone, without any intermediate forms.

The second category of methods for sexing the innominate relies on measurements. Washburn ('48, '49) has publicized the ischium-pubis index. This is an index calculated from measurements taken on this bone, and allows anyone who can use calipers to estimate sex with an accuracy of over 90%. There are two problems connected with this method, however. The major problem is that the method requires that most of the greater part of this bone be intact so that the required measurements may be taken. Those who have worked with prehistoric skeletal material know only too well that the material is often fragmentary, and the conditions necessary for the required measurements are not met with too often. A minor problem is that the method requires the taking of two measurements and the calculating of an index, and the comparing of the index with a chart which gives the male and female values. This procedure takes time. This is not so noticeable when one is dealing only with one or two skeletons, but when a whole series is under study the

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process can be very time consuming. One finds himself wishing there were a method of sexing which had the accuracy and the objectivity of the ischium-pubic index, but which was not so time consuming and did not require that almost the whole bone be intact.

This paper deals with a newly developed technique of sexing the hip bone which is accurate, rapid, highly objective, and which does not require years of experience for accurate application. The average researcher should be able to use the technique successfully after reading this paper.

The method was first suggested by observations of the apparently clear-cut relative differences between the area of attachment of the crus penis and crus clitoris respectively, on the male and female ischiopubic ramus (Grant et al., '65). Detailed examination of a number of pelves of known sex showed that this criterion was not discrete enough, nor accurate enough to provide the desired accuracy when used alone. This led to the inclusion of two additional criteria, the ventral arc and the sub-pubic concavity, which proved to be essentially discrete in character, requiring no comparisons of relative development of a structure. In nearly every case, these latter two criteria were either present or absent, and their presence or absence had a definite meaning. This eliminated almost all incidence of ambiguity due to intermediate expression of a specific criterion.

At the outset of the present research, it was hypothesized that the use of the three criteria to be described would produce accurate results in estimating the sex of an innominate. This hypothesis was tested on 275 adult individuals from the Terry Skeletal Collection, which were made available for study through the kind cooperation of Dr. Mildred Trotter, who also selected the major portion of this sample. Table 1 shows the nature of this sample in detail.

Owing to the limitation of time available, it was decided that this preliminary research should take the form of a simple test of the accuracy of the hypothesized method. The test consisted of examining the pelves of the 275 individuals and estimating the sex of each one according to the three criteria under consideration. These estimates were recorded and then compared with the cadaver records for confirmation. It was found that of the 275 individuals in the sample only 11 had been incorrectly sexed. Upon re-examination of the incorrectly sexed bones, it was found that at least three were incorrectly sexed because of carelessness and an unfamiliarity with the weight which should be given to each of the three criteria. Nevertheless, the results in table 2 were obtained. These results were taken as confirmation of the usefulness of the technique. But, there is every indication that more detailed research of these criteria could result in refinements of the technique which would allow even greater accuracy.

The ventral arc. Figure 1A shows the ventral aspect of the female pubis and ischio-pubic ramus. Arabic numeral 1 indicates the ventral arc. In order to observe this criterion correctly, one must orient the pubis so that the ventral surface is directly facing him, and the pubic symphysis is in an anterior-posterior plane. The ventral arc has been observed by the present writer only on female pubes. It is a slightly elevated ridge of bone which extends from the pubic crest and arcs inferiorly across the ventral surface to the lateral most extension of the subpubic concavity (see below) where it blends with the medial border of the ischio-pubic ramus.

Figure 1B shows the ventral aspect of the male pubis and ischio-pubic ramus. The male pubis has no ventral arch. The male may, however, possess a similar ridge,

TABLE 1

Number in test sample

	Negro	White	Total
Males	20	160	180
Females	52	43	95
Total	72	203	275

TABLE 2

Accuracy expressed as percentage of individuals correctly sexed

	Negro	White	Total
	%	%	%
Males	95.00	95.62	95.56
Females	94.23	100.00	96.84
Total	94.44	96.55	96.00

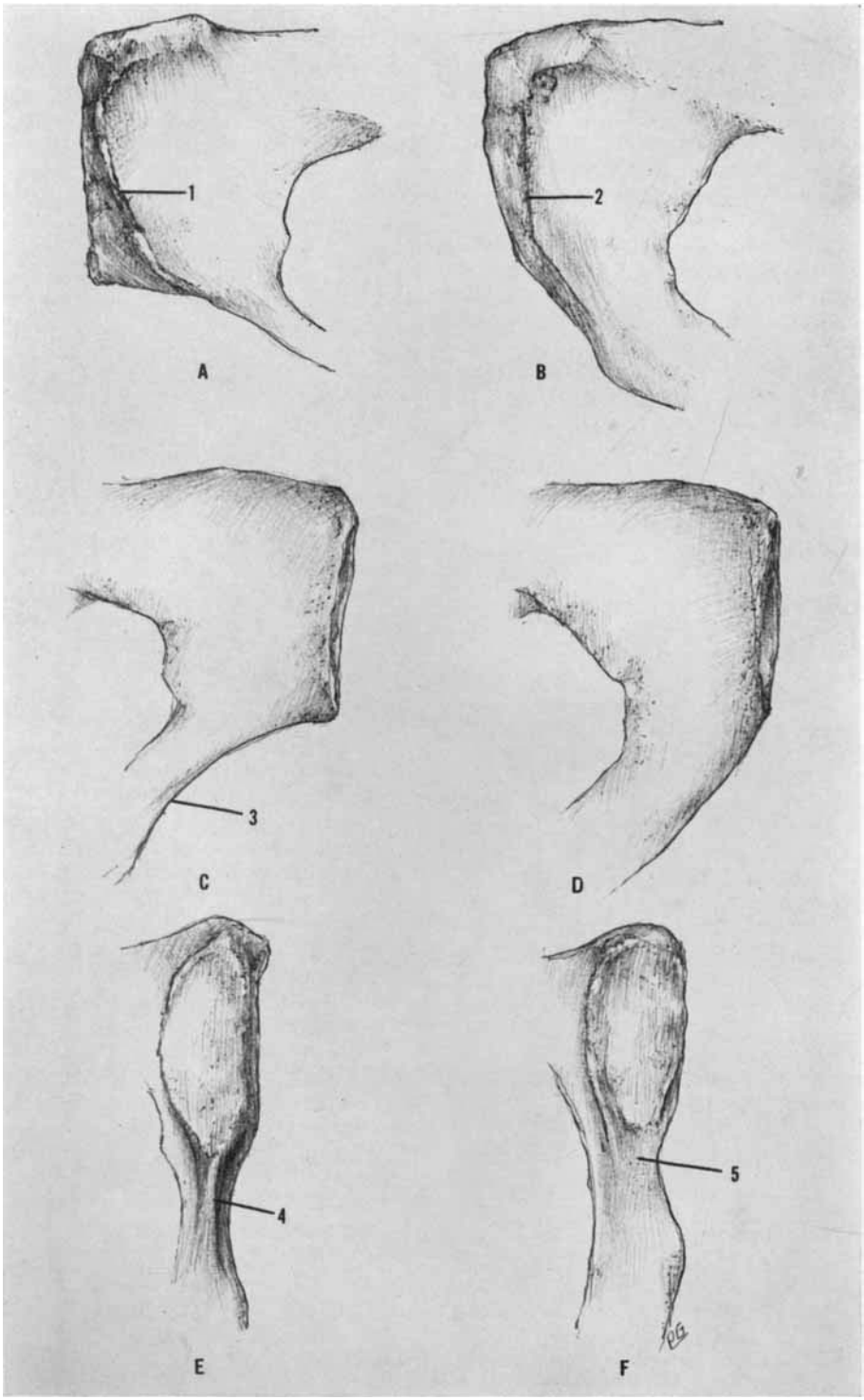

Fig. 1. A-1 Ventral arc on ventral surface of the female pubis. B-2 Slight ridge on ventral aspect of male pubis. C-3 Subpubic concavity seen from dorsal aspect of female pubis and ischio-pubic ramus. D Dorsal aspect of male pubis and ischio-pubic ramus. E-4 Ridge on medial aspect of female ischio-pubic ramus. F-5 Broad medial surface of male ischio-pubic ramus.

(arabic numeral 2) but this should never be confused with the ventral arc if proper observation is carried out. In the first place, the pubis must be oriented as described above. Secondly, close examination shows that the ridge when it occurs on the male pubis does not take the same course as the ventral arc. In the male, the ridge will usually take one of two courses. Either it will extend from the pubic crest or pubic tubercle infero-*medially* to the inferior margin of the pubic symphysis, or it will extend from the pubic crest inferiorly, parallel to the medial border of the pubis, to a point superior and lateral to the subpubic angle where it too forms an angle and extends for some distance along the ischio-pubic ramus parellel to its medial border. Figure 1B shows an example of the latter. But, these lines are easily distinguishable from the slowly arching course of the female's ventral arc.

The subpubic concavity. Looking at figure 1C (dorsal aspect of the female pubis and ischio-pubic ramus) one can see a lateral recurve (3) which occurs in the ischio-pubic ramus of the female a short distance below the lower margin of the pubic symphysis. Figure 1D shows that this is absent in the male pelvis. This criterion is not quite as objective as the ventral arc. Some males show a slight hint of a subpubic concavity. However, this number is exceedingly small, and even when a trace of a subpubic concavity appears in a male it is almost always quite difficult to confuse this with the well developed trait in the female. Therefore, this, like the ventral arc, is essentially an objective, discrete criterion which does not require that one compare relative amounts of development between the sexes in order to sex a particular bone.

Medial aspect of the ischio-pubic ramus. Figure 1F shows the medial aspect of the male ischio-pubic ramus. Arabic numeral 5 indicates the broad surface which is found on the ischio-pubic ramus immediately below the symphyseal surface in the male. Figure 1E shows the medial aspect of the female ischio-pubic ramus. Arabic numeral 4 indicates the ridge which is found here in the female in contrast to the broad surface in the male. Most male pelvis will have a broad flat surface here, but there is a certain degree of intergrading between males and females in this criterion. Heavy reliance should be placed on this criterion only in the absence of the areas of the bone where the other two criteria are found.

Procedure of estimating sex. When one uses the three criteria outlined above, it must be kept in mind that not every os pubis will be a perfect male or female. On occasion the ventral arc may not be well developed in a female, or a male may show a hint of a subpubic concavity, or the medial aspect of the ischio-pubic ramus may be intermediate between the male and female morphology. It must be pointed out that such variability is to be expected, but it presents no really serious problem. When there is some ambiguity concerning one, or rarely, two of the criteria, there is almost always one of the criteria which is obviously indicative of male or female. If the estimation of sex is based on the one or two criteria which are definitely male or female, the estimate will be right at least 96% of the time as was shown by the test on the Terry skeletal material. The medial aspect of the ischio-pubic ramus is the criterion most likely to be ambiguous and the ventral arc is the least likely to be ambiguous.

It must be stressed that this technique has only been tested on adult material. It should not be relied upon for sub-adult material without further testing, for there are indications that the ventral arc and the subpubic concavity are not well developed until the female has reached about 20 years of age.

Table 2 indicates that there are some racial differences in the accuracy of the technique. Though these are not great, it should be born in mind that a slightly lower accuracy is to be expected when sexing remains of a population with which the researcher is less well acquainted.

In spite of the drawbacks just stated, one will find that with a minimum of practice, most researchers will be able to use the technique to accurately sex almost all adult innominates in a matter of a few seconds, using only a very small portion of the bone. It is also conceivable that further study would provide a combination of this technique with other visual criteria which would allow even beginners to sex hip

bones with an accuracy approaching 100%.

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