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Original communication

Sex determination using mandibular ramus flexure: A preliminary study on Indian population

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ABSTRACT

Determination of sex by morphological assessment has been one of the oldest approaches in forensic anthropology. Loth and Henneberg[6] introduced a morphological trait "Mandibular Ramus Flexure" for sex identification with a high accuracy of 99% in African Blacks. However, the population specificity of sexually dimorphic features is well known. The purpose of this study is to test the reliability of this trait in Indian population. A total number of 112 adult mandibles (88 males and 24 females) were studied from the Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, India. The mandibles were scored according to the original method by two observers in three different sessions. This was done to test inter and intra-observer errors in identifying the trait. The result shows that this trait can be used to diagnose sex with an average accuracy of upto 82%. Though, inter and intra-observer errors were present but could be minimized with extended practice. So, the trait has the potential to be relied upon as a single morphological trait for determination of sex in Indian population.

1. Introduction

The role of an anthropologist in a forensic setting is, to create a biological profile of unknown skeletal or decomposed remains, to arrive at conclusions regarding its age, sex, stature and ethnic background. Sex determination is one of the leading questions addressed when formulating the biological profile. Its knowledge refines focus of identification restricted to one sex only. The subsequent methods for age and stature estimation are also sex dependent as growth and maturation differs in sexes.

Traditionally, subjective visual assessments of sexually dimorphic features of the skull and pelvis are resorted to for sex identity. Morphological methods are not population specific, with suits application to fragmentary archaeological and forensic materials. Moreover, the method encapsulates morphological information that is difficult to quantify using standard anthropometric techniques.[1]

It has been stated that descriptive traits are more influential in sex determination from skulls than metric assessment of size and proportions.[2] Mandible is one of the most durable and dimorphic bone of the skull[3] and important for sex identification. Several studies evaluated the utility of sexually dimorphic human mandible using metric and morphological features.[3–10] It is found that dimorphism is generally more marked in mandibular ramus than in the mandibular body.[4] Mandibular ramus can differentiate between sexes as the process of mandibular development and masticatory forces are different for males and females which influence the shape of the ramus.[6,11]

Mandibular ramus flexure discovered by Loth and Henneberg[6] has drawn world-wide attention due to its exceptionally high accuracy in sex determination. The distinct flexure in the posterior border of ramus at the level of occlusal surface of the molars in adult males is not seen in females, if present, it was either above or below the occlusal surface. The authors claimed prediction accuracy of 90.6–99% in mandibles without loss of molar teeth. Thus far several studies have examined the usefulness of this method.[3,12–20] Koski[12] in radio-cephalometric study on white children (6–8 years) and young females (22–25 years), found no difference in sexes in

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Fig. 1. Male mandible showing ramus flexure (+1) score.

Fig. 3. Female mandible showing +1 score.

occurrence of mandibular ramus flexure. Similar observations were reported by Hu et al.[3] Other studies supported the findings of Loth and Henneberg in favor of the method.[14,19] The expression of ramus flexure has been suggested to be population specific and thus present investigation attempted to examine occurrence of this trait and its sex discriminating ability in Indian population.

2. Material and method

The samples were collected in the Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India. It comprised of 112 adult mandibles (88 males and 24 females) between the age group of 18–60 years, from forensic cases. Pathological mandibles having more than two ante-mortem molar teeth loss were excluded from the study.

The mandibles were scored according to the methodology of Loth and Henneberg.[6] Mandibles with ramus flexure at the level of occlusal surface were scored as +1 (Figs. 1 and 3), while straight ramus or flexure above or below the level of occlusal surface, were scored as −1 (Figs. 2, 4 and 5) and mandibles with no obvious flexure were scored as 0. For each mandible the scores for the right and left ramus were added. Mandibles with scores of 0 to +2 were identified as males and mandibles with scores of −1 and −2 as females. Left and right sides were scored separately at different time.

The ability of identifying a morphological trait by one or more observer is crucial to test its potential in determination of sex. Previous researchers reported difficulties in identifying the flexure, so inter and intra-observer errors were also calculated by Kappa statistics. For this, the mandibles were scored by two observers at different time and in three different sessions. The time gap between each session was two weeks to avoid any bias. The data was analyzed using SPSS statistical package.

3. Results

Table 1 presents a glance of previous researches on ramus flexure conducted on different populations employing different observation techniques.

The scores of ramus shape obtained by two observers (V.S and R.S) are presented in Table 2. Fifty two of male mandibles (59.1%) exhibited bilateral flexure i.e. scored '+2' whereas 18 (75%) female mandibles showed bilaterally straight ramus i.e. scored '−2'. Similar observations were obtained by second observer where 38 males (43.2%) showed bilateral flexure and 17 females (70.8%) showed bilaterally straight flexure.

The predictive accuracy for males and females is presented in Table 3. It is obvious from this table that 17 of 88 males have a female shape (−1 and −2 score) and 3 of 24 females have male shape (0, +1 and +2 score) thus only 82.1% mandibles (80.7% males and 87.5% females) were correctly assigned by first observer. Second observer found slightly lower accuracy and correctly identified 77.7% mandibles (males 77.2% and females 79%).

Fig. 2. Female mandible showing straight border (−1) score.

Fig. 4. Male mandible showing straight ramus (−1) score.