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HOMO—Journal of Comparative Human Biology 55 (2005) 229–237
Journal HOMO of Comparative Human Biology
www.elsevier.de/jchb

Predictive accuracy of sexing the mandible by ramus flexure

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Received 26 December 2003; accepted 15 July 2004

Abstract

Loth & Henneberg (Am J Phys Anthrop 99 (1996) 473) described a single morphological indicator of sexual dimorphism, namely the presence or absence of flexure on the posterior border of the mandible, with a predictive accuracy of 90.6–99.0%. In the other studies, which have criticized mandibular ramus flexure as sex indicator in adult and fossils specimens by the same method, the accuracy of sexing was found between 59.0% and 80.4% which is well below the reported 90.6–99.0% (Am J Phys Anthrop 107 (1998) 363; Am J Phys Anthrop 111 (2000) 573; Am J Phys Anthrop 111 (2000) 429; Homo 53 (2002) 97). It was indicated that the method sexed males more reliably than females and consistency was low. In the current blind test, 120 mandibles from forensic cases were examined for the presence or absence of mandibular ramus flexure. Virtually identical results were obtained when a second observer examined the same sample of mandibles. The results were then compared to records of the same cases resulting in 85.8% accuracy for the total sample. A marked difference was observed between sexes where the ramus shape was diagnostic for 92.6% of the males but for only 60.0% of the females ($p < 0.001$). When mandibles with excessive tooth loss (more than two molars missing) ($n = 35$) were removed from the sample (in normative sample), the overall predictive value increased to 90.6% (95.6% accuracy in males and 70.6% in females). Our results confirm that

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doi:10.1016/j.jchb.2004.07.006

there are marked differences between the sexes in the predictive accuracy and this indicator is better in mandibles without molar tooth loss as mentioned by Loth & Henneberg. They also pointed out that the tooth loss is a potential source of error. On the other hand, in this study, there were no sexing errors when mandibles which ramus shape scores −1, 0 and +1 were extracted from the normative sample as the "sex indeterminate group". This study suggests that further assessment should be made only when both rami are available for observation, and the mandible shows either bilateral flexure (+2) or bilateral non-flexure (−2). The consideration of this new categorization can also be useful when using Loth & Henneberg's method.

Introduction

Identification on skeletal and decomposing human remains is one of the most difficult skills in forensic medicine. Sex determination is also an important problem in the identification. If almost all the bones composing the skeleton are present, sex estimation is not difficult. When the skeleton exists completely, sex can be determined with nearly 100% accuracy. This estimation rate is 98% for pelvis and cranium, 95% with only pelvis or pelvis and long bones, and 80–90% with only long bones (Krogman & Işçan 1986). However, in explosions, warfare, aircraft crashes and, other mass disasters such as earthquake, identification and sex determination are difficult. The mandible is one of the durable bones in these situations. There are many studies of sexual dimorphism in the human mandible including morphometric and morphologic indicators. Loth & Henneberg (1996) described a single morphological feature of the mandible, the presence or absence of a distinct flexure on the posterior border of the ramus at the occlusal plane, as an indicator of sex with up to 90.6–99.0% accuracy in mandibles without molar tooth loss. On the posterior border of the mandibular ramus at the level of the molar occlusal plane, adult males typically exhibit a flexure or angulation, which is usually absent in adult females and juveniles of both sexes. It has been hypothesized that this flexure is caused by the forces exerted by muscles of mastication that occur during puberty as a response to hormonal changes and transmitted to the teeth through the cantilevered body of the mandible producing a bending force in the bone (Loth & Henneberg 1996; Indrayana et al 1998).

Many test studies have been performed to evaluate the predictive accuracy of mandibular ramus flexure as a morphological indicator of sex. In a blind test, Hill (2000) examined 158 mandibles for the presence of flexure as defined by Loth & Henneberg, resulting in 79.1% accuracy and a marked intraobserver error. Hill suggests that mandibular ramus flexure is an unreliable technique to use for the estimation of sex, due to both its low overall accuracy and invalid scoring system, as well as the high incidence of intraobserver error. In another blind test study of mandibular ramus flexure by Donnelly et al (1998), only 62.5% of the mandibles were correctly sexed and the second observer obtained virtually identical results.