Sexual dimorphism in base of skull

Anabel Amores-Ampuero

1 Laboratory of Anthropology, Department of Legal Medicine, Toxicology and Physical Anthropology, School of Medicine, University of Granada Granada 18012, Spain
anabelamores3@gmail.com

With 1 figure and 4 tables

Abstract: Sex determination is an important task in forensic medicine and physical anthropology. The aims of this study were to assess the presence of sexual dimorphism in the base of the skull and to compare the accuracy of sex estimation by this method with that achieved in other metric studies of this region. The sample comprised 109 individuals (53 males and 56 females) of known sex, age, and cause of death from San José cemetery in Granada (Spain). Six dimensions were analyzed and discriminant function analysis was performed. The discriminant capacity of the selected variables was then evaluated by using a cross-validation procedure. All dimensions were significantly higher in males than in females. The percentage accuracy was 75.7% (77.8% for males and 73.7% for females). Highest dimorphic values were for occipital condyle length and foramen magnum width. Skull base measurements should only serve to corroborate findings.

Keywords: forensic anthropology; sexual dimorphism; discriminant function analysis; foramen magnum; occipital condyles; skull base

Introduction

Sex identification is challenging if only parts of the skeleton are available or the pelvic bones have been damaged, and a combination of approaches is usually required, based on morphological and/or anthropometric characteristics (Wescott 2000). Anthropometric methods offer greater objectivity as long as adequate reference data (formulae) are available for the population under study, given that traits that are sexually dimorphic in one population may be less dimorphic in another. For their part, morphological methods are more subjective and dependent on the observer. Other techniques include molecular studies based on the analysis of DNA, when this is preserved (Jiménez-Brobeil 2010), although these are mainly applied in subadult remains or when morphological and metric methods have proven inadequate, given the technical resources required (Suazo et al. 2008).

Several studies have quantified the degree of sexual dimorphism in the foramen magnum, and all found the foramen magnum to be significantly larger in males (Holland 1986; Catalina-Herrera 1987; Gümay & Altinkök 2000; Murshed et al. 2003; Çiçekcibasi et al. 2004; Suazo et al. 2009). In addition, various authors reported that discriminant functions from foramen magnum and occipital condyle dimensions correctly classified 65–81% of individuals (Uysal et al. 2005; Gapert et al. 2008; Suazo et al. 2009; Gapert et al. 2009). However, the accuracy rates in some of these studies represented non-cross-validated values and are likely to overestimate the predictive accuracy of these functions (Uysal et al. 2005; Suazo et al. 2009). Likewise, the classification accuracy rates recorded by Holland (1986) in a metric study of 100 skulls, the highest reported to date, were not cross-validated values. In fact, when he applied his functions to a test sample not involved in the formulation of the regression equations, the accuracy rate decreased from 90% to 85%.

The skull base is more likely to be preserved than other bones due to its relatively well-protected position and covering with a large volume of soft tissues. It is therefore of interest to examine the usefulness of this region for sex estimation in incomplete or damaged skeletons.

The objectives of this study were i) to estimate the degree of skull base sexual dimorphism in a Southern Spanish population, and ii) to compare the accuracy of the resulting sex estimations with that obtained in other metric skull base studies.

Material and methods

The sample comprised 109 adult Mediterranean individuals (53 males and 56 females) from a large and expanding collection of identified infants, young children, and adults.