Forensic Anthropology Population Data

Reliability of the Suchey-Brooks method for a French contemporary population

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A B S T R A C T

The Suchey-Brooks method is commonly used for pubic symphyseal aging in forensic cases. However, inter-population variability is a problem affected by several factors such as geographical location and secular trends. The aim of our study was to test the reliability of the Suchey-Brooks method on a virtual sample of contemporary French males.

We carried out a retrospective study of 680 pubic symphysis from adult males undergoing clinical Multislice Computed Tomography in two hospitals between January 2013 and July 2014 (Toulouse and Tours, France). The reliability of the Suchey-Brooks method was tested by the calculation of inaccuracy and bias between real and estimated ages, and the mean age for each stage and the mean stage for each 10-years age interval were compared.

The degree of inaccuracy and bias increased with age and inaccuracy exceeded 20 years for individuals over 65 years of age. The results are consistent with an overestimation of the real age for stages I and II and an underestimation of the real age for stages IV, V and VI. Furthermore, the mean stages of the reference sample were significantly lower for the 14–25 age group and significantly higher for individuals over 35 years old.

Age estimation is potentially limited by differential inter-population error rates between geographical locations. Furthermore, the effects of secular trends are also supported by research in European countries showing a reduction in the age of attainment of indicators of biological maturity during the past few decades. The results suggest that the Suchey-Brooks method should be used with caution in France. Our study supports previous findings and in the future, the Suchey-Brooks method could benefit from re-evaluation of the aging standards by the establishment of new virtual reference samples.

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1. Introduction

In forensic or physical anthropology and paleoanthropology, estimation of age at death from osteological features is a major area of interest. In this field, the pubic symphysis has been the most studied of the anatomical structures used in estimating age at death. The Suchey-Brooks method is commonly used for pubic symphyseal aging in forensic cases and the least open to criticism in terms of methodology. It was developed using a large reference sample of known age ($n = 1255$) and has been widely tested on osteological collections different to the reference sample [1–4]. The method was developed on an American sample of individuals autopsied between 1977 and 1979, however, biological age presents important inter-population variability. For male individuals, the Suchey-Brooks Sample (SBS) (reference sample) included 720 dry pubic symphysis (mean age, 40.5 years; minimum age, 14 years; maximum age, 92 years and SD, 18) [1]. Could a forensic anthropologist use the Suchey-Brooks method to accurately estimate the age at death of an individual whose bones have been found in France today?

Several factors can contribute to the problem of inter-population variability. Firstly, differences could be related to the geographical origins of the population. Klepinger in 1992 recommended population specific methods and some researchers have

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highlighted the need for regional standards for estimating age in various populations [3,5,6]. Further, secular trends are a well-known phenomenon in physical anthropology which contribute to the explanation of human variability. This phenomenon was originally studied in the case of increased stature but it extends to a wide variety of traits, for example maturation — which shows significant changes in successive generations [7–9].

The aim of our study was to test the reliability of the Suchey-Brooks method on a virtual sample of contemporary French males.

2. Material

2.1. Sample

We carried out a retrospective study of pubic symphysis from adult males undergoing clinical Multislice Computed Tomography (MSCT) in two hospitals between January 2013 and July 2014 (Toulouse and Tours, France). We choose to focus on male individuals because age estimation depends on determination of sex. The MSCT examinations were mainly requested in the clinical context of abdominal diseases. Patients with a known history of bone disease or pelvic trauma and patients with materials causing artifacts such as hip replacements were excluded. The patients were globally representative of the present-day French population. A total of 680 MSCT examinations of male individuals were included. The data and images were recorded anonymously with only the sex and the age of the patient recorded at the time of the CT. According to French law, the results of medical imaging examinations may be used retrospectively without the patient's consent when these examinations have been carried out for clinical purposes and when they have been recorded anonymously (article 40-1, law 94-548 of 1 July 1994).

2.2. MSCT

MSCT images were obtained through a Picture Archiving and Communication System (PACS, McKesson Medical Imaging Group, Richmond, BC, Canada) used by both hospitals. Examinations were performed on a Sensation 16 Scanner (Siemens, Erlangen, Germany) with 16×1.5 mm collimation. The image matrix was 512×512 pixels. A soft tissue filter was used. Depending on the purpose of the examination, axial reconstructions were performed every 2 mm. Scans were saved as Digital Imaging and COmmunications in Medicine (DICOM) files, and post processing was performed using Amira 5.4.2 software (Mercury Computer System, Inc., Chelmsford, MA).

3. Methods

3.1. Morphological 3D analysis

The left pubic symphysis was chosen arbitrarily. Reconstruction of the polygonal surface was performed using Amira® software with the Isosurface function. The pubic symphysis was isolated and edited with the ExtractSurface and Surface Editor functions. A stage was assigned to each pubic symphysis using morphological criteria and the methodology proposed by Suchey-Brooks [1]. Staging was consensually performed by two experienced observers. All images were analyzed without knowledge of the age of the subject and in arbitrary order. Observers could rotate the bone in three dimensions. Six pubic symphysis representative of each stage are illustrated in Fig. 1.

3.2. Precision studies and summary statistics

Data used in this study were collected by two observers. To examine the effects of intraobserver reliability, the principal
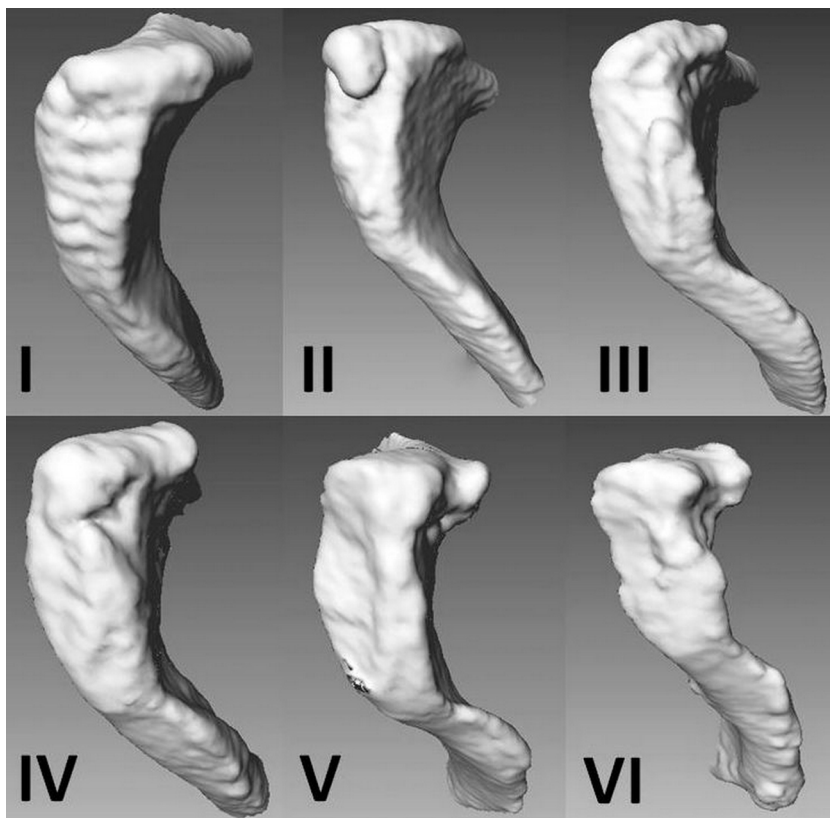

Fig. 1. Pubic symphysis representative of each stage using the morphological features proposed by Suchey-Brooks.