

Reliability of the methods applied to assess age minority in living subjects around 18 years old A survey on a Moroccan origin population

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Abstract

We present a review of a population of 114 immigrant Moroccan males for which an age estimation was requested. The subjects' real chronological age was confirmed by the Moroccan Embassy in Spain. The confirmed age range was between 13 and 25, with an average age of 18.1 years and a standard deviation of 2.03. The following tests were performed to arrive at the forensic estimation of age: general physical examination, carpus X-ray (Greulich and Pyle method) and dental orthopantomography to determine the degree of maturity of the third inferior molars (Demirjian's method). Carpus X-ray (skeletal age) was the most useful method, followed by Demirjian's method (dental age), as prediction factors of a chronological age of over or under 18. The combination of skeletal and dental age variables represented a significant improvement in the prediction of the chronological age of the subjects in this population, reducing the number of ethically unacceptable test errors to a minimum. © 2004 Elsevier Ireland Ltd. All rights reserved.

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1. Introduction

Spain is the second country in the European Community with the largest number of illegal undocumented immigrants. Minors are subject to special Spanish and community regulations which are different from those applied to subjects over 18. According to these regulations, under 14-year-old subjects are exempt from criminal liability, minors between 14 and 18 are subject to special criminal standards, and persons over 18 but under 21 could be subject in the

future in Spain to the criminal standards now applied to minors under 18. Illegal immigrants under 18 may be placed under the guardianship of the authorities.

Both in a clinical setting and in the specific field of forensic medicine, there is a growing demand by the courts for appropriate medical tests aimed at estimating the approximate age of supposed minors without documentation.

In the year 2000, the Arbeitsgemeinschaft für Forensische Altersdiagnostik der Deutschen Gesellschaft für Rechtsmedizin published its guidelines for the forensic estimation of the chronological age of living individuals subject to criminal proceedings [1]. These guidelines recommended the performance of the following tests to determine majority or minority of age (18 years) for criminal purposes, in living subjects:

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1. Physical examination: anthropometric measurements (weight, height, build); inspection of signs of sexual maturity; identification of diseases which could alter maturity development.
2. X-ray examination of the left hand.
3. External examination of the condition of teeth and dental X-ray.
4. X-ray examination of the *medial clavicular epiphyseal cartilage* [2], to confirm if the chronological age is over or under 21.

When interpreting the results, the guidelines themselves recommend that data from the tests above should be compared with reference studies relevant to the specific individual in question. They finally recommend that, when the final expert assessment has been made, the results of each of the tests performed should be recorded separately and that the age estimated should be identified as the most probable, specifying the degree of probability of each estimated result.

In Spain, there are several studies on our national population according to which the recommended tests can be interpreted with the pertinent adjustments in assumed minors of Spanish origin. Most illegal immigrants without documentation are from Morocco. In this case, the forensic estimation of their age is difficult because no systematic studies have been conducted in that country that could inform us of the maturity parameter variations applicable to its population.

This article presents a study conducted in a population of immigrant males, supposedly minors and of Moroccan origin. The purpose of the study was centred on analysing the efficacy of the tests available to estimate approximate chronological age and, particularly, the reliability of an age estimation of 18 or more, attempting to reduce the number of ethically unacceptable errors to a minimum.

2. Material and methods

The population sample on which the study was conducted consisted of a total of 114 males of Moroccan origin, supposedly minors, and illegal immigrants in Spain. The original studies were requested by the Juvenile Division of the Public Prosecutor's Office of the Basque Country.

Confirmation of the subject's date of birth was obtained from the Moroccan Embassy in Spain while processing their residency applications. Along with this information, the chronological age for this study was calculated in relation to the date of the X-ray examinations performed on the supposed minors.

The study conducted on this population sample consisted on the following examinations and additional tests:

1. Physical examination: basic anthropometric measurements (weight, height and body mass index, or BMI), inspection of signs of sexual maturity (stage of evolution of pubic hair P1–P6 using Tanner's method; Table 1),

Table 1

Stages of pubic hair development, according to Tanner [10]

| | |
|----|---|
| P1 | No hair |
| P2 | Some pubic hair around the root of the penis or on the labia majora, not recognizable on a full body photograph |
| P3 | Dense hair within defined limits, visible on a photograph |
| P4 | Dense hair like that of adults, but less extended |
| P5 | Dense and widespread hair with a horizontal upper limit and spreading sideways towards the thighs |
| P6 | Triangular growth up to the navel |

general physical examination and personal interview to rule out the existence of disease.

2. X-ray study of the hand and wrist.
3. Dental maturity study: this included a general examination of the oral cavity and an X-ray examination of the stage of maturity based on dental orthopantomography.

The data from the physical examination and the external examination of the oral cavity was obtained by the forensic physician on duty, who was responsible for this examination.

The hand and wrist X-rays and the dental orthopantomography were performed in the Basurto Hospital's radio-diagnosis department. The data obtained from the hand and wrist X-rays were interpreted using the Greulich and Pyle method [3].

The data from the X-ray examination of dental maturity was centred on assessing the stage of evolution of the third inferior molars in both dental arches. The degree of maturity was quantified by Demirjian's stage system, unaltered, stages A–H (Table 2) [4]. Although not originally devised by Demirjian et al. to quantify third molars maturation, the method has been previously applied for this purpose in several scientific papers. Demirjian's stage system has been applied in this research following A.B.F.O. (American Board of Forensic Odontologists) recommendations published in 1993 by Mincer et al. [5]. The quantification of the third superior molars was ruled out since it was impossible to interpret them on the orthopantomography plates because bone contours overlapped the molars, making it difficult to see them entirely.

The two X-ray studies were interpreted by three of the raters (Greulich and Pyle's method) or by two (Demirjian's method). Two of them (PMG, MAS) have been regularly responsible for interpreting these tests in the Basque Legal Medicine Institute since 1999. The third author (MIL) is a forensic doctor unaccustomed to performing this kind of X-ray assessment. When making his assessments, the third author had no more than the instructions provided in the original text of the Greulich and Pyle system (1959 edition). She received no specific instructions on how to apply the methods from the other two authors. This study has been based on the interpretations of the carpus X-rays by investigators PMG, MIL and MAS and the interpretations of the orthopantomographies by investigators PMG and MIL.

The results of the above studies were analysed by the fourth author, a specialist in statistical research in biome-

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