HOW OLD AM I? AGE ESTIMATION IN LIVING ADULTS: A CASE REPORT

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ABSTRACT

Age estimation is a common task in forensic medicine. Odontologists are frequently involved in the age assessment of human remains or living juveniles. The need to estimate the age of living individuals is becoming more frequent, because of the increasing number of immigrants (illegal or otherwise) without acceptable identification documents and with missing or uncertain birth dates. Whereas age estimation in subadults is usually performed by methods based on the physiological growth of bones and teeth, in the case of living adults age determination is more difficult, because body maturation has come to an end and the most commonly used procedures in forensics on human remains are too invasive for the living individual.

The following case report aims at highlighting the difficulties of performing age estimation in the living adult and the importance of a multidisciplinary approach including forensic odontology: a middle-aged woman from Ethiopia who was supposed to be 62 years old (according to one set of documents), was removed from employment lists as she had reached the retirement age for Italy. However another set of documents indicated a younger age (46 years). Hormonal dosage of E2 (17-β estradiol) and FSH (Follicle Stimulating Hormone) showed an age close to the begininng of menopause. An experimental dental method, based on the decrease of canine pulp chamber with age, was performed in order to obtain more information: the result was an estimation of a 47-57 age range. Combined results suggested that it was more likely that the actual age of the woman was closer to 46 than to 62.

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INTRODUCTION

Age estimation has quickly become a very active field of research in forensic sciences; in recent years age estimation in the living has become a more frequent request from courts. Its main application has been on subadults, concerning the verification of imputability in subjects, often immigrants, lacking valid identification documents. Commonly used for this task are analyses of hand and wrist ossification according to the Greulich and Pyle atlas[1], Tanner-Whitehouse[2] and FELS methods[3], radiographic analysis of the clavicle's sternal articular surface[4,5], dental methods based on a parodontic radiograph, and an in detail analysis of third molar development, among which Demirjian[6,7,8] and Mincer[9,10] stadiation are frequently used in the juridical context. In the living special attention must be given to the most frequently indicated age thresholds for imputability provided by laws in different countries (14, 16, 18, 21 years), although ethnic and sexual variability should be considered. Difficulties in age assessment in case of the living were stressed in 2001 by *The Study Group on Forensic Age Diagnostic*[11]; the group has proposed guidelines for age estimation in the living, with a three-step procedure including a physical examination concerning anthropometric analysis and sexual development assessment, dental analysis by panoramic radiograph, and radiographic study of the left hand; if the 21 year threshold is considered, clavicle sternal end radiographic examination is also suggested.

However living adults are a greater problem for age assessment.

Age estimation in the living more and more commonly concerns adults, frequently over 50 years of age, without identification documents, and is usually requested in order to verify if they have reached retirement age limits; the subjects are often immigrants, who cannot indicate with precision their date of birth and therefore their chronological age. When they are supposed to have reached retirement age, a pension may be provided by the welfare system, sometimes with removal from employment lists. This phenomenon is destined to increase in the next few years: e.g. in Italy 2,402,157 legal immigrants were registered up to 2005, among whom only 579,714 under 20 (24.1%); 75.9% of cases are adults[14]. In order to maintain their employment, or to ask for retirement, an age estimation is required; in these cases very few methods can be used.

Age determination in the living adult is more difficult because body maturation has come to an end and the most commonly used procedures in forensics on human remains are too invasive. An attempt at age estimation in living adults was performed by Ritz-Timme *et al.* using the aspartic acid racemization technique from dentine[12,13].

Although this lacks standardization, the authors report a high precision; however, dentine biopsy is invasive, although the authors report that the technique is of low risk13. Furthermore the method is expensive and complex.

One other method may involve radiological observation of pulp chamber reduction, discussed by Kvaal *et al.,*[18]. More recently Cameriere *et al.,* have taken these notions into consideration again and suggested the use of the ratio between the pulp chamber and tooth area from canine tooth radiographs[15,16,17]. The method is based on the physiological decrease of pulp chamber volume - which, as mentioned previously - has been analyzed by other dental methods of age estimation[18], and concerns 2D metrical measurements of parameters on a radiograph; this method is based on a similar procedure to Kvaal's, but attempts to measure areas and standardize the measurements by using computer software. The ratio between the measured area of a tooth and the area of its pulp chamber is calculated on a digitalized panoramic radiograph with the aid of specific software (Photoshop®). The values are inserted in a regression formula, which provides the age of the subject with an error of +/- 5 years. The first results published by the authors are encouraging, although more research needs to be performed. At present, this may be the only feasible age estimation method for living adults, though it still has to be assessed on different populations.

This case report provides an example of age estimation in adults and highlights difficulties of the age estimation process in the living, and some possible solutions.

CASE
A woman required age estimation after she was removed from employment lists because she had reached, according to the welfare system, the retirement age threshold (65 years for men, 60 years for women) in Italy. She had arrived in Italy as a young woman with her family as a war refugee. Identification documents provided by the claimant (given to her by her father) indicated that she was born in Asmara (Ethiopia) on January 1st 1944 (giving her an estimated age of 62 years). Her father however had told her that in order for her to qualify at the time as a political refugee he had had to falsify the documents to make her appear older. In fact other documents subsequently found by her relatives pointed out a birthdate of January the 1st 1960 (an estimated age of only 46 years). The claimant did not know how to prove one or the other. She only remembered she arrived in Italy in 1984, when she was an adult. After she arrived to Italy, she gave birth to two sons, in 1985 and in 1990.

Although this circumstantial evidence seemed to indicate a "younger" solution, it could not exclude that she had had her last son at the age of 46.

To verify the woman's theory the judge requested an expert opinion which involved a forensic pathologist, a forensic odontologist and a gynaecologist. During the medical examination, the woman showed an apparent age between 45 and 55 years, based on general external appearance (initial skin wrinkling and hair greying); the claimant had brought previously performed vertebral, knee and chest radiographs, which provided no indication of severe degenerative pathology. She reported she had always been in perfect health and that since 2001 her menstrual flow had come to a halt.

The gynaecological examination pointed out dystrophy of external genitalia, ectropion, and normal vaginal trophism, without pathological signs. Ultrasound revealed a fibrous uterus, with thinning of the endometrial rima, and ovaries without follicles.

A hormonal dosage aimed at E2 (17-β estradiol) and FSH (Follicle Stimulating Hormone) rate analysis, which give an indication of ovarian function, was performed. The results indicated the beginning of menopause.

A panoramic dental radiograph (PDR) was performed in order to verify the ratio between pulp chamber and dental area from canines, according to Cameriere's method[15,16,17]. A digital periapical radiograph of the right maxillary canine was also taken. The PDR was digitized using a Nikon Coolpix 5000 camera (Fig.1). With the aid of Adobe Photoshop® CS2 the forensic odontologist measured the areas of the right maxillary canine and its pulp chamber on both the PDR and periapical radiograph (Figs.2,3). Copies were sent by e-mail to another odontologist who used the same method with similar results: 47 to 57 years of age with a 52 year mean age.

DISCUSSION
In living adults, age estimation techniques commonly used in the deceased are not feasible. Aspartic acid racemization requires a dentine biopsy with consequent limits concerning the invasive procedure, possible complications, technical problems in replicability and *standardization* as well as time and costs. The only indication of age may come from the examination of sexual characteristics and hormonal dosage, although a high racial and inter-individual variability must be considered. In this case, gynaecological and hormonal tests showed that the woman was at the beginning of menopause; the mean menopausal age is

reported to be 49.5 - 51 years among the South African black population[19,20], 48.28 years among the Western Kenyan black population[21], without significant variation concerning social and economic factors: these data agree with the age estimation provided by the Cameriere *et al.* method which indicated an age between 47 and 57 years, with a mean of 52 years[15,16,17].

In conclusion, gynaecological tests and the dental method indicated an age of 48-52 years; these data are more consistent with the possibile date of birth provided by the relatives (January 1st 1960). The "ageless" woman kept her employment and now has to wait 14 years to retire. This was what she wanted, as she would have considered retirement inappropriate for her lifestyle, as did not "feel" 60.

This case report has provided no real solution to the problem, but has indicated some possible paths to pursue and the importance of a multidisciplinary approach. There are currently no recommendations concerning the correct age estimation procedure to apply on living adults, and very little experience; in fact, none of the commonly used methods are reliable enough in case of adults. In this case the Cameriere *et al.* method indicated a 10 year age range. However a combination of gynaecological and dental information provided a sensible age estimation and an orientation towards one of the two hypotheses.

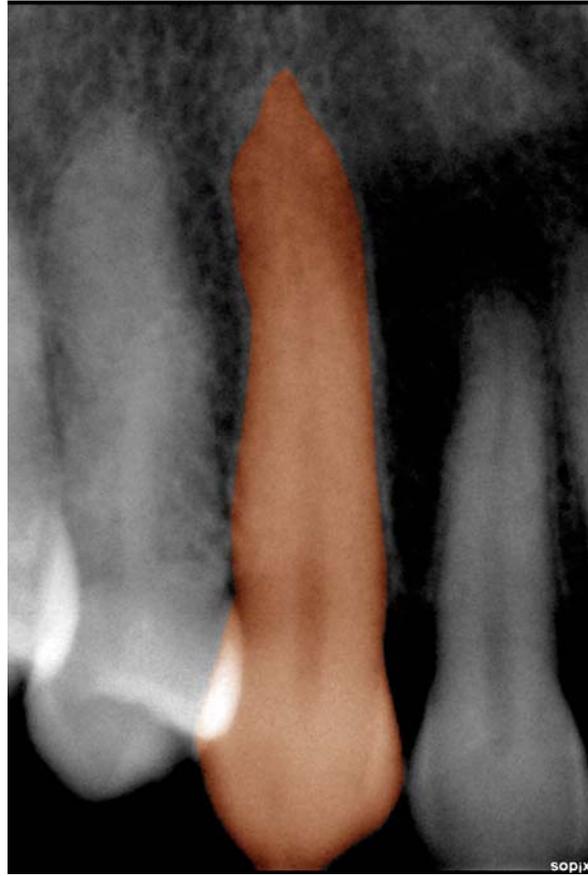***Fig. 1:*** *Detail of the right maxillary canine in the digital x-ray.*

Fig. 2: total canine area highlighted by Photoshop® computer software.

Fig. 3: Pulp chamber area highlighted by Photoshop® computer software.

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